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Cutting the Cost of Molding Sheave Wheels

How Molding Machines are Employed for Making the Molds and Cores and the Economies They Effect

By E C Kreutzberg

CAST IRON sheave wheels, while not large in themselves, constitute an important part of the output of foundries which produce castings for elevator and cableway installations. The universal practice in producing a sheave wheel is to cast it horizontally in a green sand mold, the drag portion of which is provided with a print to support the circular core used for forming the rope-groove in the rim of the wheel. Usually this core is made of dry sand, in six segments; it requires approximately 20 minutes to make one complete core for a wheel of average diameter, without taking into consideration the cost of baking and handling, or the time required for placing the segments in the mold.

Core Making Machine

This method of making cores for sheave wheel molds has been done away with by the Otis Elevator Co., which recently designed, for its own use, a machine for making these cores of green sand. Two of the machines already have been constructed and are said to be giving satisfactory service. They have been installed, one each, at the Otis foundries at Harrison, N. J., and Quincy, Ill. Each is operated by two men, who turn out the green sand cores at the rate of one in 1½ to 2 minutes. In addition to making the cores at a greatly reduced cost, the machines turn them out in complete circles, thus making it unnecessary to assemble them in segments as formerly. A further advantage is that the resulting castings require less machining, since the elimination of the core joints tends to

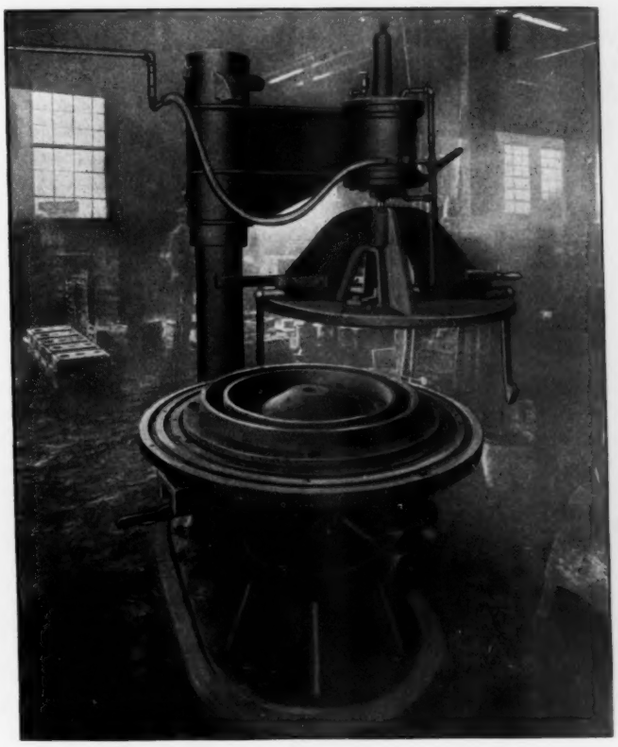


FIG. 1—MACHINE FOR MAKING GREEN SAND CORES FOR SHEAVE WHEEL MOLDS

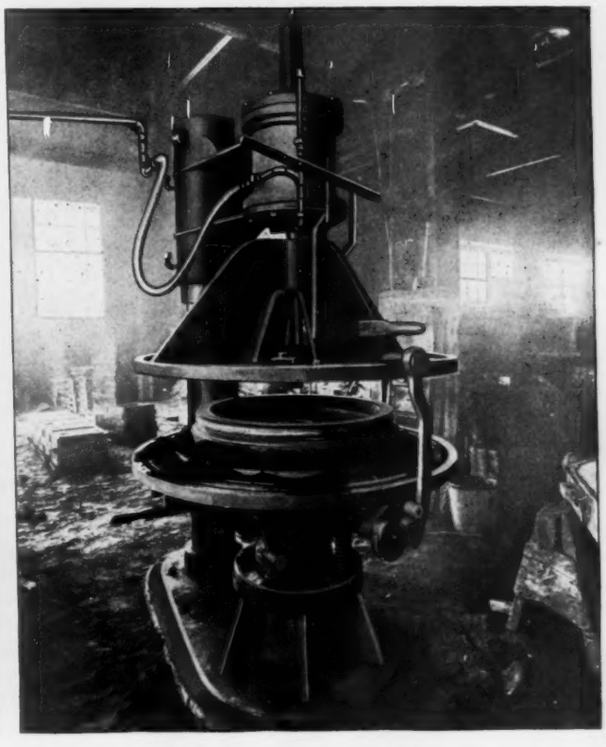


FIG. 2—CORE RING, WITH COMPLETED CORE, RAISED FROM CORE BOX AND READY TO BE REMOVED TO MOLDING FLOOR

FIG. 3—DRAG, AS MADE ON JOLTING MACHINE, ALSO SHOWING DRAG PORTION OF PATTERN

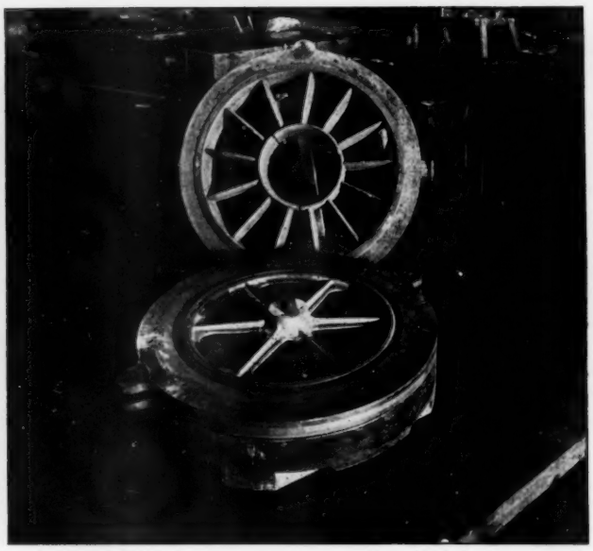


FIG. 4—PATTERN WITH COPE RING, AND COPE SECTION OF FLASK

do away with imperfections in the rims of the wheels.

The core machine, as shown in Figs. 1 and 2, is of the top ram variety, and somewhat resembles in construction certain French types of molding machines.. It consists essentially of a bottom, or molding, table, and a top, or plunger, table. The bottom table is mounted upon a 3-foot cast iron column, 8 inches in diameter, which rests upon the cast iron base of the machine. This table, which is immovable, is provided with concentric slots of varying diameter. The top table is provided with bolt holes which also are arranged in corresponding concentric circles. The top table is of the swinging type. It is mounted on a plunger which operates in an air cylinder. The latter is located at the end of a bracket, supported by a second cast iron column, 8 inches in diameter and 7 feet high, which also stands upon the cast iron base of the machine.

The concentric slots and bolt holes in the bottom and top tables are designed to correspond with the equipment necessary for making cores of any particular diameter or depth. This equipment, in every case, consists of a cylindrical, cast iron, core box and a top and bottom ring, which conform, respectively, to the top and bottom of the core box. The core box is bolted to the surface of the bottom table, the bottom ring being lowered through the core box into the corresponding slot in the table; the top or ramming ring is bolted to the top table. The bottom ring, on being placed in the proper slot, rests upon four pins which project upward from what is known as the "cross-arm". This consists of a cast iron collar from which four cast iron arms, which carry the pins, extend horizontally, at right angles to each other. The cross arm may be moved up and down, thus imparting a vertical motion to the bottom ring, which has the same function as an ordinary stripping plate. The cross arm derives its upward motion from the top table, the downward motion being accomplished by gravity.

FIG. 5—A 24-INCH, TWO-ROPE, SHEAVE WHEEL, AS CAST WITH GREEN SAND CORE

The cores are made on cast iron core rings, and, since the core ring and core must be placed in the mold together, it necessarily follows that there must be a separate core ring for each mold. The core rings have a cross section like that of a hollow, truncated cone, the inner surface being designed to support the green sand core and the outer surface to fit the core print in the mold. In making cores for a particular diameter of sheave wheel, the first step is to equip the two tables with the proper core box and top and bottom rings. The bottom ring is then lowered by releasing a spring pin which supports the cross arm, and a core ring of the right diameter is placed in the core box. The machine then appears as it is shown in Fig. 1. Next, green sand is shoveled into the core box and the plunger table lowered, thus ramming the core. The end of the plunger tapers off to a point, which engages a tapered hole in the center of the bottom table; in this manner the plunger table is guided in its downward motion, and it is impossible for the top-ring to overlap the core box.

The plunger table operates on compressed air at a pressure of 80 pounds per square inch. In its downward motion, two hooks, which are suspended from it, automatically engage lugs on the side of the cross arm. After the sand has been rammed, the motion of the plunger table is reversed, thus raising the cross arm. As a consequence, the core ring, with the completed green sand core, is raised out of the core box, as shown in Fig. 2. The core ring, with core, then is lifted off the machine and carried away to the molding floor. Next, the cross arm again is lowered, after which another core ring is placed in the core box and the operation repeated.

The patterns which are employed by the Otis Elevator Co. in making sheave wheel molds, are of the usual variety, being of wood. They consist of the drag section, on which the drag

is molded, and a cope ring, which fits over the drag section for making the cope. The molds are made in circular cast iron flasks, being put up on a Pridmore jolt machine, which has a 5 x 5-foot table. The molding practice is along customary lines. The drag first is rammed up and turned over, as shown in Fig. 3. The cope ring then is placed over the pattern, as shown in Fig. 4, and the cope rammed up and turned over. The core ring, carrying the green sand core, then is placed in the drag, as shown in Fig. 6, after which the mold is closed. The gate is in the cope, as usual. These molds are completed at the rate of one in 15 minutes. Fig. 5 shows a 24-inch, 2-rope, sheave wheel, which was made with a green sand core.

Removing Sulphur with Manganese

By W. J. Keep

Question:—We always were of the opinion that manganese removes sulphur from cast iron by forming manganese sulphide, but I have never heard how much manganese removes a certain amount of sulphur in a certain number of minutes, depending upon how the iron is stirred or agitated. Suppose I have an iron that taps from the cupola as follows: Silicon, 1.75 per cent; sulphur, 0.11 per cent, and manganese, 0.50 per cent. I want to reduce the sulphur to 0.06 per cent. What percentage of 80 per cent ground ferro-manganese shall I sprinkle into the iron at the tap hole to accomplish this reduction in sulphur and still have the manganese in the finished casting 0.50 per cent? As soon as the reservoir ladle is nearly full, the iron with the ferro-manganese in it is stirred with a 3-inch diameter green wood pole, which will make it boil violently. This boiling will last for five minutes. The iron will then be allowed to rest for two or three minutes and poured from the bottom of the reservoir ladle.

If an iron which analyzes 2.00 per cent silicon, 0.08 per cent sulphur and 0.50 per cent manganese is satisfactory in the machine shop, how much can I reduce the silicon without injuring the machining qualities, if the manganese remains unchanged in quantity and the sulphur is reduced to 0.07 per cent? If the sulphur is further reduced to 0.06 per cent, how much additional silicon can be safely removed without injuring the machining qualities of the iron?

Answer:—It might be advisable for you to try out all of these suggestions and analyses of the various products will easily demonstrate the results. These trials will upset some of your theories and will make more of an impression on you than the results of experiments by others. The theoretical statements contained in your inquiry are founded on some experiments and the results to be achieved are very much desired. However, a foundry cupola will not always give the results that are desired from a furnace of this type. While you are making the experiments it will do no harm to briefly answer some of your questions. You cannot incorporate all of the powdered ferro-manganese in molten iron regardless of the amount of stirring, as some of it will float on top of the metal. Therefore, you will succeed in mixing only a very small amount with the metal. Probably you will accomplish equally as well or better results by the use of ferro-manganese in the size of marbles, but you cannot melt much of this metal in this form. One of the reasons for this is that the melting point of ferro-manganese is much higher than that of iron. When used in the Bessemer converter the ferro-manganese first is melted and then is added to the metal. You frequently will find by analysis that a casting contains chemical equivalents of manganese and sulphur, that is, the compound did not leave the iron and pass off with the slag as expected.

You also may find that the saving of silicon by a reduction of sulphur is not a financial success even if it can be accomplished. If powdered ferro-silicon could be blown into the bottom of a ladle full of molten metal, it would combine with some of the sulphur and the sulphide would rise to the top. This probably is the only way to effect this combination. Even in this case considerable of the ferro-manganese will pass through the metal without being incorporated with the fluid iron. For this reason no definite percentages of reduction could be effected. Sulphur, up to 0.11 per cent, has little influence on the hardness of the castings if the iron is melted hot. The damage is done during the process of melting by sulphur which is not left for the chemist to find. With the low prices prevailing for raw materials, it is advisable to purchase coke and iron low in sulphur and to melt the iron hot. Gray cast iron will not take up much sulphur, as the silicon and carbon prevents its union. However, if you take a carload of coke and a carload of each iron in the mixture and run a week on a given mixture, some days the sulphur will amount to 0.07 per cent and on other days it will be as low as 0.04 per cent. This is due to atmospheric conditions which are not apparent to the senses. Let me state again that it is not necessarily the elements which the chemist finds in the final casting that does the harm, but the influence of the chemical parts of alloy during melting. A dose of medicine may do wonders to a human being, but after it has passed through his system a chemist might find no trace of the cause by analysis of any part of his anatomy. A successful founder will find chemical analysis a great help and theoretical knowledge is very valuable, but care also should be exercised in the purchase of raw materials and in the methods of charging the cupola.

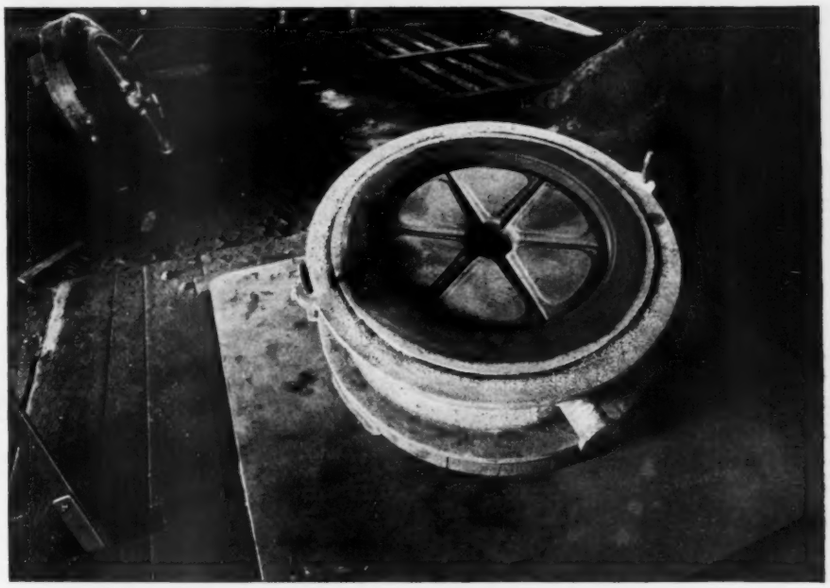


FIG. 6—VIEW OF DRAG AFTER PLACING GREEN SAND CORE

Notes on Foundry Practice by a Trade Veteran

A Discussion of Casting Shop Requirements to Obtain the Best Results, with a Description of a Skim Gate

AS an introduction to this discussion on "Foundry Practice," I will direct your attention to the many advantages possessed by the State of New Jersey in its mineral deposits, which are so essential to the iron and steel industry. These advantages, I think, are not as thoroughly appreciated as they ought to be by those who are familiar with them, and only those who are too far away to utilize your clays, sands and gravels feel the great need of them in their daily practice.

New Jersey is a rich state as a clay producer; fire, stoneware and brick clays extend from Trenton and Bordentown on the Delaware river in parallel lines about 10 miles wide, east to the Raritan river at New Brunswick on the north, to the vicinity of Chetwood on the Raritan Bay, on the south. Immense quantities, aggregating thousands of millions of tons, of light or yellow clay, underlie all the territory east of a line drawn from Asbury Park, west to Freehold, and southwest to the Delaware river at Salem, to the Atlantic ocean.

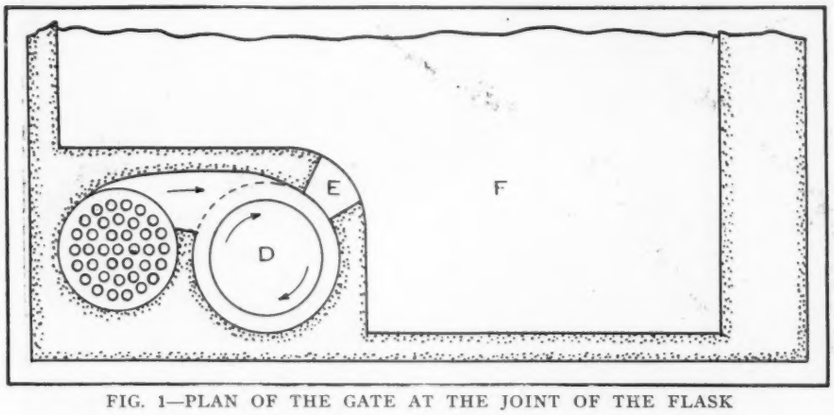


FIG. 1—PLAN OF THE GATE AT THE JOINT OF THE FLASK

These are known as the Asbury or Cohansey clays, and are used for making building brick. These deposits generally underlie sand and gravel. After the deposit of the clay, there was formed what is known as the "Pensauken Basin", a considerable depression of the earth within the line bounded by Freehold to Mt. Holly, extending to a point within five miles of the Delaware river, south to Bridgeton and Millville; from there it extends east to Tuckahoe, and then within 10 to 15 miles of the Atlantic coast to Freehold.

Within this basin, for centuries, was deposited the Red or Jersey gravel, having an admixture of enough clay to make it sufficiently plastic for foundry purposes. This is the only gravel in the United States, so far discovered, that is sufficient in itself to make loam without the addition of any other material. This is the reason why so many large pipe foundries are located in this district.

This gravel takes the place of fire sand in many shops. It is a natural combination of fire sand and clay, in almost the exact proportions to make loam or dry sand work without further admixture other than water. It can be mixed with old loam in a pan grinder, which produces a satisfactory mixture to mud the bricks. After being swept up, the pure gravel and water is sieved through a No. 6 or No. 8 riddle, and a fine slurry for a finishing coat is obtained. It makes a loam that the iron will lay against without kicking. It also is used for dry sand work. In the oven it dries hard and solid, and is used by the largest firm of locomotive builders in this country for molding cylinders; one concern purchasing fully 15,000 tons annually for this purpose.

The fact that it can be used without the necessity of combining it with other materials, makes it the cheapest material for dry sand or loam work that has ever been mined. For cores it also is economical, as it requires very little, and at times, no binder, such as flour, core compound, resin or molasses to bond it. In some shops it is used without a binder. After the core is made, and while still green, it is sprayed or swabbed with molasses water; the core then is coated with blacking mixed with strong molasses water, so that in drying the outside of the core hardens, which prevents it from drying too soft or having the skin rubbed off in handling.

New Jersey also is noted for its molding sand deposits, especially the celebrated Lumberton sand, used extensively from Nova Scotia in the east, to Pittsburgh and Buffalo in the west, wherever fine machinery castings are made.

This sand also is used for copes of molds having large hanging surfaces with a tendency to draw down, such as planer beds. By mixing about one-third Millville gravel with the sand and allowing the cope to air-dry while the drag is being dressed and the cores set, it will become hard and dry and will not draw down or sag when the mold is poured.

Sleeking Facings

Plumbago, silver leads, talc, carbon facings of all grades, native graphites and refractory minerals in general should be rubbed in with the hand if possible, or with a camel's hair brush. They never should be sleeked with any metal tool, except where a corner sleek has to be used to finish a square or rounding corner in the mold.

This reminds me of an incident that occurred in a foundry in Detroit, where I was foreman, about 1880. One of the molders always insisted upon hard sleeking, and the resulting castings were scaly or had a thin scab on the flat surface. Once we had an order for a heavy engine bedplate, weighing over five tons, with the pillow block and leg cast on. I permitted the molder to draw the pattern and then I would finish the mold and black it. It was bedded in the floor, made in green sand and was not even skin-dried. After finishing, I rubbed Ceylon plumbago over the mold with my hand and fingers, using a small, square corner slick and a half round one to sleek the corners. When I climbed out of the mold the molder asked if he should finish sleeking it. I said, "It is finished, we will now set the cores and close the mold." He said, "Boss, if you are going to close the mold and pour it that way, you, of course, will be responsible for it."

The next morning when we started to lift the casting out of the pit, there

From an address delivered by Jos. S. Hibbs, of the J. W. Paxson Co., Philadelphia, before the Newark (N. J.) Foundrymen's Association.

was quite an audience of molders and others from various parts of the works to see what this casting looked like. As the crane hoisted it out of the pit the sand began to peel off, and when it was clear of the floor, one or two taps of a heavy mallet cleaned every particle of sand from the casting.

I have recounted this incident, more especially to impress on your minds the fact, known by every intelligent molder, that a beautiful, smooth, shining surface does not always mean an equally smooth castings.

Ceylon graphite cannot be used alone and in a dry condition on green sand castings. If it is dusted on a mold in a dry and pure state it will either run before the iron when the metal is poured, and if a thin casting it will produce a "cold shut." If the casting is heavy, the facing will wash into a corner and make the casting show a curl, or if it has a riser, the facing will blow out of it. Pure graphite can be used on green sand, if strong molasses water is sprayed over the whole mold after it is sleeked. Pure Ceylon graphite can be used advantageously for wet blacking for molds and cores, if clay or molasses is added to the water in which it is mixed. Ceylon plumbago gives better results when mixed with other minerals. For instance, if used for thin castings, when the mold must be sleeked or brushed, high grade talc is mixed with it. This is done for two reasons, first, so that it will not follow the tool, and second, the talc serves as a bond to hold the plumbago to the sand. For certain purposes, the mixture of gas house carbon or a high grade of hand-picked 72-hour coke will materially raise the percentage of carbon in the mixture and make it more refractory.

Cupola Lining

Mica schist, which now is being employed extensively for lining cupolas, is a firestone, or micaceous sandstone. As a natural rock it neither expands nor contracts from heat or cold. It was first used about 25 years ago by Bessemer steel manufacturers for lining converters, being the only known substance that can be subjected to a temperature of 3,500 degrees Fahr. without expanding. The cost of lining a cupola with mica schist is slightly more than that of laying brick. When first lining a cupola with this material, a stonemason should be employed who has been accustomed to laying foundation walls in stone, as he understands the process of filling in with spalls. The stone, not being uniform in size, at times projects too far inside the cupola and has to be chipped off. It should be laid edgewise in a vertical position. The edges of the stone then are exposed to the heat and are less likely to spawl off or burn, and have greater resistance to abrasion than if laid with the flat side of the stone exposed. The larger pieces are laid in place next to each other in each circle, and the spaces between are filled in with the smaller pieces, so as to make an almost compact mass. The small pieces can be ground in a cinder mill and mixed with enough water to make a thick mortar and thrown in all the openings so as to fill all the cracks. After the first heat the lining will have the appearance of a stone wall.

Fire brick have two opposite properties, namely resistance to heat and resistance to abrasion. High resistance to heat or refactoriness requires high silica, while resistance to abrasion requires close, hard-burned alumina or clay; therefore, a happy medium has to be attained in fire brick to combine both qualities. Cupola brick should analyze about 50 per cent silica and 50 per cent alumina, or as near those proportions as possible. High carbonate of lime should never be used for flux in a cupola; it does not liquify the slag like a dolomite limestone, and dolomite does not give as good results as fluorspar. Slag must be liquified so as to run freely and not hang to the lining or stick to the fuel in the furnace or clog the slag hole. The lower tuyeres in a cupola should be placed to suit the work to be poured, and no rule can be made as to a standard height. Where hand ladles are used and metal is poured continuously for small work, the lower tuyeres can be placed as low as five inches above the bed, thereby saving fuel and preventing the burning of the iron.

One of the most successful cupolas for melting stove plate I ever saw was in the foundry of Gage & Horton, St. Louis. The tuyeres were only five inches above the bed, and the cupola was never stopped-up from the time it was first tapped until the bottom was dropped. Cupolas in foundries operating on heavy work should have the lower tuyeres high enough to permit of holding sufficient iron to weigh at least one-half the weight of the heaviest casting made. No lower tuyere should be higher than one-half the diameter of the inside of the lining. If only one set of tuyeres is used, the first bed of fuel, after the bed has settled, should be from 12 to 20 inches higher than the tops of the first row of tuyeres.

The reasons I limit the height of the fuel above the lower tuyeres and the height of the tuyeres above the bottom follow:

The first bed of fuel is always the largest, and the proportion of metal melted is less in proportion than the rest of the heat.

The large amount of fuel below the tuyeres is not reached by the blast, and consequently the oxygen does not reach it in sufficient quantity to increase the melting capacity.

The danger of chilling in the tap hole when the bottom is too far below the tuyeres.

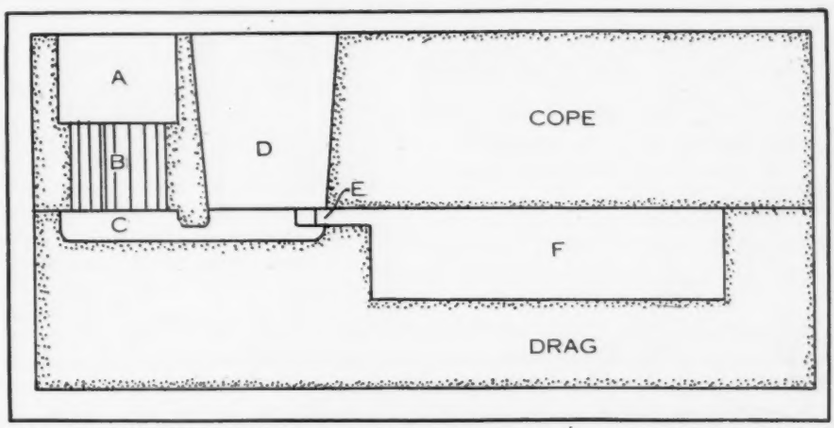


FIG. 2—SECTIONAL VIEW OF THE MOLD; THE BLOCK HAS BEEN WITHDRAWN AT *A*; *B* ARE THE $\frac{3}{16}$-INCH HOLES EXTENDING TO THE JOINT; *C* IS THE RUNNER IN THE DRAG; *D* IS THE RISER; *E*, SPRUE TO THE CASTING AND *F*, MOLD FOR CASTING

As a rule, the foundry is the least appreciated of all departments of a plant, yet it requires more brains to run and to make pay than any other. The machine shop has its blue prints made in the drafting room, and simply finishes its work to size as shown by the drawings. The pattern shop takes the drawings from the drafting room and makes the patterns by tool and rule. The drafting room gets its ideas from the mechanical engineer, who most likely gets his suggestion from his employer. In the foundry, however, endless problems are presented when a new job is received. The foreman must decide how it should be molded, in what proportions the facing sand should be mixed, what particular kind of facing should be used, whether the pattern should be molded in green sand, dry sand or loam, how the mold should be gated and poured, where to put the

riser, etc., if a long or flat casting is to be made, the question is whether to lift the cope off or whether to strip it to keep it straight; the kind of iron to use, and whether it should be taken from the first, last or middle of the heat. The foregoing are all questions that must be decided by the foreman.

The foreman of a foundry also is held responsible, whether properly or not, for the quality of casting. Some foundries purchase their iron by analysis and the mixtures are ordered by a chemist. I am strongly in favor of advanced methods, but the responsibilities should always be on the shoulders of the manager.

The molder who is anxious to advance, in his leisure moments should study the following subjects:

The manufacture of pig iron.

Materials used in pig iron manufacture.

Effect on iron of such elements as phosphorus, sulphur, carbon, manganese, silicon, etc.

Why different pressures of blast are used.

Why different fuels are used.

How iron is assorted for various uses.

Different methods of charging.

How the cupola should be tapped.

How the cupola should be slagged, and with what flux.

What grades of iron should be used for different work.

Clean Castings

I cannot close this subject of "Foundry Practice" without referring to a method of securing clean castings by the use of a cleaner gate, which I devised 35 years ago, and since its introduction it has been used advantageously by many foundries.

A round, flat, end block is used, about one-half the depth of the cope in which it is to be set, and this is drilled lengthwise full of 3/16 to 5/16-inch holes. depending upon the size of the casting to be poured. In ramming the cope, this block is rammed in it so that it is flush with the top of the cope, and located just where the pouring sprue would be placed. Before lifting the cope a rod, 3/16 to 5/16 inch in diameter, is pushed through the holes in the block to just make an impression in the drag. Then the block is lifted out with a draw spike and the cope is lifted. At the point where the impressions through the cleaning block are shown, a gate, in the form of a quarter circle, is cut to a riser cleaning gate.

A cleaning riser which has been set in place and rammed with the cope, then is drawn out of the cope and the runner from the riser is cut into the mold in a reverse direction from the movement of the iron, as shown in Fig. 1. It will be apparent to any foundryman that the dross, as soon as it reaches the cleaning riser, will immediately ascend in the riser and will not enter the mold. The molten iron strikes the cleaner riser before it has any opportunity of passing into the mold. It will be noted that the cleaner riser is over twice the area of the pouring gate. This is done for the purpose of relieving the pressure at the runner discharging into the mold, and to allow the lighter particles of dross to immediately ascend in the riser. The runner *A* should be about twice the area of the runner *B* so as to have sufficient pressure to keep the iron sufficiently high in the riser. In fact, the gate should be poured fast enough to keep it not only full, but also the riser itself.

There may be some criticism regarding the space occupied by this gate in the flask, but a clean casting is worth the time required to ram a shovelful or two of sand, and pays better than having to add it to the scrap pile.

Modern Pipe Casting

An interesting development in pipe foundry labor-saving methods that has come into almost universal use at the present time is a multiple-lip ladle so constructed that it pours from four points at once. Six-foot gas and water pipe, and standard five-foot soil or waste pipe has always been casted horizontally, the multiple pouring having been used, as this gave a more perfect pipe. The shifting of cores and the consequent varying of wall thickness in the pipe was largely eliminated and a more perfect distribution of the liquid metal obtained. It was necessary, however, for the men who did the pouring to make a great many trips to the nearest source of supply of the molten iron, whether that was the furnace itself or the bull ladle, filled at the furnace and moved to the most advantageous points. The pouring also took a long time, and more men could not be put on to hasten the process as they would merely get in each other's way.

It was to get away from these closely limiting factors that induced the foundry operators to devise and develop the multiple-lip ladle for pipe-pouring work. This ladle is built in the shape of a shallow, cast iron bath tub, lined, of course, with fire clay to prevent its rapid burning out. It is supported at each end by a pin, pivoting in a bearing formed by the looped end of an arm that hangs from a chain hoist. The hoist, in turn, is supported on a trolley or craneway that is part of an overhead track system, centering at the cupola or furnace and extending over the floor space upon which the casting is done. These ladles are filled from the cupola and will hold half a ton or more of iron. The workmen are protected from the great radiated heat of the molten iron by shields either fastened to the supporting arms or covering the ladle itself. Long handles attached to each side of the ladle at its opposite ends provide means for tilting and guiding the ladle so that it will deliver the iron through the four lips into the proper openings provided in the top of the pipe mold.—*Scientific American.*

Casting Steel Spokes into Hubs

By W. J. Keep

Question.—We are experiencing trouble in casting the spokes of wheels into the center boss. The ends of the arms are coated with red lead and turpentine to prevent the metal from blowing around them. The metal around the arms is solid, but does not fuse onto the arms and after working the wheels for a short time all the spokes become loose. The dimensions of the arms are 2½ inches wide by ⅝ inch thick and the metal is poured into the mold very hot.

Answer.—The mixture you are using is the best obtainable to prevent the iron from fusing the spokes. Make a 50-per cent solution of silicate of soda, that is, water glass, and paint the spokes. When this coating becomes sticky, sprinkle it with finely powdered ferro-manganese. You might use the silicate of soda as thick as cream, but it should not be thicker than necessary to hold a complete coating of the powdered ferro-manganese. It probably is impracticable for you to heat the spokes coated in this way and to insert them in the mold just before pouring.

Whiting Crane Catalog

A new catalog covering electric traveling cranes recently has been issued by the Whiting Foundry Equipment Co., Harvey, Ill. The details of Whiting cranes of various types are fully illustrated and carefully described and a large number of illustrations are published showing Whiting crane installations in various shops throughout the world. These illustrations are grouped in an attractive and convenient manner and similar types of cranes are shown together.

"How You Can Make Savings" is the title of a circular issued by David McLain, Goldsmith Building, Milwaukee, and points out how his course in foundry practice reduced losses entailed in the manufacture of a gear from 20 to 30 per cent to 5 per cent in five days.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

STANDARD SPECIFICATIONS FOR LOCOMOTIVE CYLINDERS

1.—Locomotive cylinders shall be made from good quality, close-grained gray iron cast in a dry mold.

CHEMICAL PROPERTIES AND TESTS

2.—Drillings taken from the fractured end of the transverse test bars shall conform to the following limits in chemical composition:

Phosphorus.....not over 0.90 per cent
Sulphur.....not over 0.12 per cent

3.—A check analysis of drillings taken from the transverse test bar may be made by the purchaser, and shall conform to the requirements specified in Section 2.

PHYSICAL PROPERTIES AND TESTS

4.—When placed horizontally upon supports 12 inches apart and tested under a centrally applied load, the arbitration test bars, specified in Section 6 (*a*), shall show an average transverse strength of not less

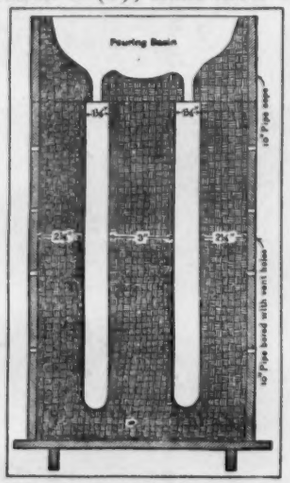


FIG. 1.—MOLD FOR ARBITRATION TEST BAR

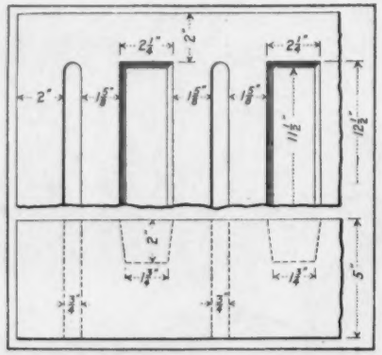


FIG. 2.—MOLD FOR CHILL TEST SPECIMEN

than 3200 pounds and an average deflection of not less than 0.09 inch.

5.—Before pouring, a sample of the iron shall be taken and chilled in a cast-iron mold, as specified in Section 6 (*b*). The sample shall be allowed to cool in the mold until it is dark red or almost black, when it may be knocked out and quenched in water. The sample, on being broken, must show a close grained gray iron, with a well-defined border of white iron at the bottom of the fracture. The depth of the white iron must not be less than 1-16 inch as measured at the center line.

(*Continued on Data Sheet No. 168*)

Adopted at the Atlantic City meeting of the American Society for Testing Materials and referred to the members for letter ballot.

STANDARD SPECIFICATIONS FOR LOCOMOTIVE CYLINDERS

(*Continued from Data Sheet No. 167*)

6. (*a*) *Arbitration Bar.*—The mold for the bars is shown in Fig. 1. The bottom of the bar is 1-16 inch smaller in diameter than the top, to allow for draft and for the strain of pouring. The pattern shall not be rapped before withdrawing. The flask is to be rammed up with green molding sand, a little damper than usual, well mixed and put through a No. 8 sieve, with a mixture of 1 to 12 bituminous facing. The mold shall be rammed evenly and fairly hard, thoroughly dried and not cast until it is cold. The test bar shall not be removed from the mold until cold enough to be handled. Bars should not be rumbled before being tested as this adds 25 per cent or so to strength. Brushed give better results.

(*b*) *Chill Test.*—The form and dimensions of the mold shall be in accordance with Fig 2.

7.—(*a*) Two arbitration test bars, cast as specified in Section 6 (*a*), shall be poured from each ladle of metal used for one or more cylinders.

(*b*) One chill test, cast as specified in Section 6 (*b*), shall be poured from each ladle of metal used for one or more cylinders. The chill specimens may be cast in adjacent molds, but in such cases a space must be provided between the molds. (See Fig. 2).

WORKMANSHIP AND FINISH

8.—Cylinders shall be smooth, well cleaned, free from shrinkage cracks and from other defects sufficiently extensive to impair the value of the castings, and must finish to blue-print size.

MARKING

9.—Each cylinder shall have cast on it, in raised letters, marks designating the maker, the date of casting, the serial and pattern numbers and other marks specified by the purchaser.

INSPECTION AND REJECTION

10.—(*a*) The purchaser or his inspector shall be given a reasonable opportunity to enable him to witness the pouring of the cylinders and test specimens, as well as to be present when physical tests are made.

(*b*) In case the inspector is not present to witness the pouring of the castings and test specimens, the manufacturer will make all tests required by the specification, and, upon demand, will furnish the purchaser with a copy of the results of his tests, and will hold the transverse and chill specimens subject to examination by the inspector. The tests made by the manufacturer shall be considered final.

(*c*) All physical tests and inspection shall be made at the place of manufacture.

11.—Unless otherwise specified, any rejection based on tests made in accordance with Section 3, shall be reported within five working days from the receipt of samples.

Floor Molding and Machine Molding Compared

In the South the Economies of the Molding Machine are not Overlooked and This Article Tells How Costs on One Job were Cut

By J P Golden

WHEN a job reaches the foundry the question of most importance is the method of molding to be pursued. In many modern shops mistakes frequently are made in mounting work on machines when the number of pieces required does not justify the cost of so mounting the pattern. Of course, it has been my experience that the more difficult the pattern is to mold, the greater will be the saving by mounting it on a machine, the economy being evident not only in the number of castings made, but in the quality of the work produced. The durability of the pattern also should be taken into consideration, inasmuch as a light, fragile pattern is more liable to be broken when molded on the floor than when mounted on the machine. Many patterns not adapted to floor work, when so used, frequently must be returned to the pattern shop for repairs, whereas if mounted on a machine, they can be made in such manner that they will last indefinitely or until the design is changed. Also, there is another class of patterns that will require a journeyman molder to mold when made on the floor, whereas when properly mounted on a machine, they can be molded by a handyman.

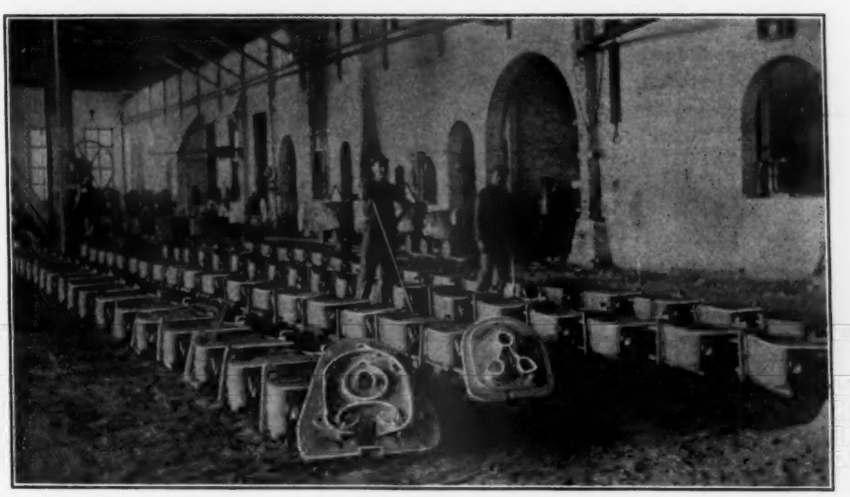
The number of castings to be made during a season, to a large extent should govern the method of molding. While several patterns on a machine ordinarily would reduce the cost of molding, yet if the patterns and special flasks necessary for machine work are expensive, it might prove more economical to do the work on the floor provided, of course, that the number of pieces is not too great.

The method of machine molding to be adopted also is of prime importance, and before the pattern is mounted it should be decided whether the mold should be hand-rammed, squeezed or jarred. Shop facilities and the grade of castings required, as well as the nature of the pattern, to some extent will govern the molding machine process. On the other hand, floor molding has its advantages owing to the fact that less costly equipment is required, and when hinged flasks are used it will be found that the equipment costs less than flasks especially built for molding machine work.

Molds for Cane Mill Work

In the accompanying illustration is shown a partial floor of 76 cane mill tops and bottoms put up in 6 hours and 40 minutes by a molder and helper. The molds were hand-rammed and the sand was hand-sifted. The total net weight of good castings obtained from this floor was 5,166 pounds. The equipment consisted of hinged cast iron flasks, and aluminum patterns mounted on boards were employed. The tops and bottoms are of a general type which the Goldens' Foundry & Machine Co., Columbus, Ga., has been making for 20 years, and as they require no machining there is considerable competition for this business. In designing a new cane mill the question of molding these parts, which weigh respectively 66 and 83 pounds each, was carefully considered and the hinged flask was decided upon. About 600 cane mill tops and bottoms will be made this season. In arriving at a definite conclusion with reference to the method of molding, all of the points regarding the advantages of the floor and machine molding were given careful consideration, and after consulting the foundry and pattern shop foreman, it was decided to give the patterns sufficient draft to permit them to be molded in hinged flasks. Very few castings are lost and the pounds per man per day is all that can be desired, inasmuch as our output is nearly double that of some of our competitors who are doing similar work by strictly hand methods.

We also have found that by limiting the number of men who can work on a job the best results will be obtained. If it is possible to employ only one man and a helper, or if the job can be done with one man alone or with the partial assistance of a helper who assists several operators, as is our practice, the highest efficiency is obtained. The results of this practice easily can be tested by comparing the results obtained by a molder working alone and a molder and helper working on a plain job. By figuring the cost per hundred pounds of castings made by the molder and helper and by the molder alone, it will be found that while the output will not be quite so great, the cost per hundred pounds of castings produced will be less when made by the molder alone than when made by a molder and helper.



FLOOR OF 76 CANE MILL TOP AND BOTTOM MOLDS PUT UP BY MOLDER AND HELPER IN 6 HOURS 40 MINUTES

The Werner G. Smith Co., Cleveland, manufacturer of a new vegetable oil for core mixtures known by the trade name of Linoil, is now located in a new plant located at Hird street and the Nickel Plate railroad. The former plant of this company, located on East Eighty-seventh street, recently was destroyed by fire. The new plant has facilities for a greatly increased output.

Proper Method of Gating Stove Plate Patterns

Obtaining Clean Castings and Reducing the Discount by the Adoption of a Simple Gate

AT THE June meeting of the Southern Michigan Foundrymen's Association, held at Kalamazoo, S. V. Blair, president of the Associated Foundry Foremen, delivered an exceedingly interesting address entitled "The Proper Method of Gating Stove Plate Patterns". He said that if proper attention is given the gating of patterns with a view of breaking the force of the metal at the point of entrance to the casting and without lessening the volume of iron introduced, it will do much toward eliminating discount now classed as *dirty iron* and *poor molding*. In applying these methods there still remains great opportunity for the exercise of individual judgment, due regard to the conformation and thickness of the pattern being necessary to so arrange the gate as to introduce metal into the mold at the proper angle. The use of small runners

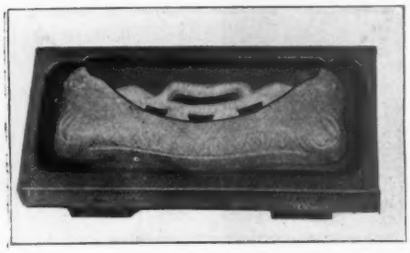


FIG. 1.—COMPOUND METHOD OF GATING BASE BURNER NAME PLATE

which contract in width from the main runner to the casting should be avoided when possible and the opposite shape, or flaring entrance used to avoid passing metal over the face of the mold in a narrow, cutting stream, the pressure from the main runner adding force without increasing the volume.

A compound method of easing the iron into a nickel-plated base burner name plate is shown in Fig. 1. It will be noted that in addition to the flaring gate at the point of entrance to the casting, an addition to the main runner provides a further safeguard against dirt and imperfections on the face of the casting. This latter addition to the gate, which is made without increasing the width of the flask, was found necessary to obtain the best results in overcoming the trouble previously mentioned.

The nickel-plated foot rail shown in Fig. 2 gave trouble for years before it was mounted on a plate. In this case two runners are used on each piece instead of six. The plate as formerly arranged is shown at the left of Fig. 2, and the pattern with only two rimers is illustrated at the right. The two runners are so arranged that the metal is uniformly distributed over the mold and the castings are poured face up. The manufacturers turning out the best nickeled trimmings today do not allow their molders to print-back their molds or use lead on the gates if the work can be saved any other way, as anything used on the face of the mold will show dark through the best job of nickel-plating. In fact, printing-back is not resorted to as much as formerly, as the use of match-plates, machines and modern processes increase, but the foundry boss doesn't always follow close on the heels of progress and is still making a lot of work face down, as our grandfathers did, just because stove plate has always been made that way.

Discount Reduced

In the case of this particular pattern the discount averaged 22½ per cent under the former method of doing the work, but after proper gating and molding face up, the discount has been reduced to 1 per cent. The same grade of sand is used and the same molders do the work as formerly at a reduction in cost, but in addition the earnings of the molders have been increased. Not every job can be improved by changing the method of gating or molding, but there are many that can, and this can be determined by trying out some of the troublesome ones in the manner described.

Foundrymen frequently have wished that they could see what parts of a mold are filled first with iron. A puzzling difficulty in proper gate arrangement is often overcome when a mold is examined that has been poured short. Pour a mold short once in a while and go after it with a scratch brush. You can see things you couldn't have seen before with the X-ray. In making stove plate, especially nickeled work, use as few runners as possible. These should be set to direct the iron over the surface at the proper angle so that all parts of the mold will fill to the main runner at the same time and as quickly as possible, aiming to keep the main runner full of metal from start to finish.

Many jobs now considered difficult can be mounted on match-plates and in many instances they can be made on squeezers by molding them face up, thereby insuring clean castings, especially when the gate is below the level of the pattern which allows the sprue to act as a cleaner and container for the iron in the process of pouring.

Speed of Melting

By W. J. Keep

Question.—We have just installed a new cupola lined to 34 inches. The height fom the sand bottom to the tuyeres is 11 inches, the upper row of tuyeres being shut-off. The cupola is equipped with six tuyeres, 4½ x 5

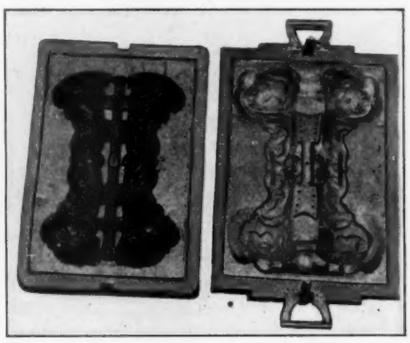


FIG. 2.—PATTERN PLATES FOR FOOT-RAILS. THE OLD METHOD OF ARRANGING THE RUNNERS IS SHOWN AT THE RIGHT AND THE NEW METHOD AT THE LEFT

inches, and we use a No. 6 Sturtevant blower. The fan is operated by a 10-horsepower motor and the blast averages 4½ ounces throughout the heat. We light the fire at 1:15 p. m., start to charge at 2:20, put on the blast at 3:25 and the first iron is tapped at 3:35. The iron is hot, but the melting is slow and we have considerable slag.

Answer.—You are melting 2¼ tons with a fuel ratio of about 7 to 1. The only difficulty seems to be with the size of your fan and motor and your blast pipe, which is only 10 inches in diameter. If these were of sufficient size to give you a blast pressure of 14 ounces, you would melt sufficiently fast to keep a head of iron in the cupola, which would hold up the slag. We would suggest that you permit the iron to accumulate in the bottom of the furnace until it reaches the bot-

tom of the tuyeres, then tap it out and stop the cupola when the slag runs. If your coke charge completely covers your iron and is about 4 inches deep, you have the proper amount of fuel. Then increase the iron charges 50 pounds each day until the melted iron shows signs of dullness. This indicates that your iron charges must be decreased a trifle to have the iron hot. Increase the iron charges up to 2,000 pounds if you can.

Special Core Ovens for Case Plant

For its new south works at Racine, Wis., the J. I. Case Threshing Machine Co. has developed a special type of oven for drying small cores. It is double-ended and is equipped with circular revolving shelves or reels. Three ovens are to be installed, each containing 30 shelves. The drying chambers are on a level with the core room floor and the grates are in the basement.

To avoid loss of heat, the floor of the oven is entirely open, the shelves being supported on re-inforced concrete beams as indicated in Fig. 1. The latter are 9 inches wide and 16 inches deep, consisting of a dense concrete mixture with a 12-inch steel I-beam running through the center.

The oven chamber is 15 feet long and 9 feet wide inside. The walls are 13 inches thick, making the outside dimensions 17 feet, 2 inches by 11 feet, 2 inches. The roof consists of flat arches of terra cotta tile carried on 8-inch, 13¾ pound I-beams. The beams are connected by ¾-inch tie rods. The tiles are 8 inches in thickness and are overlaid with a 4-inch bed of cinder concrete. The oven stands 8 feet above the charging floor which is 10 feet above the ash pit level. The rotary shelves on which the cores are placed are 4 feet in diameter and they are arranged in stacks of five, spaced 16 inches apart vertically. The shelves rotate about a steel shaft on ball bearings. The balls are 1⅛ inches in diameter. The shelves and their separating collars are split so that any unit may be removed without disturbing the others. There is a door 2 feet, 6 inches wide and approximately 6 feet high in front of each stack of shelves. The doors are of the sliding type.

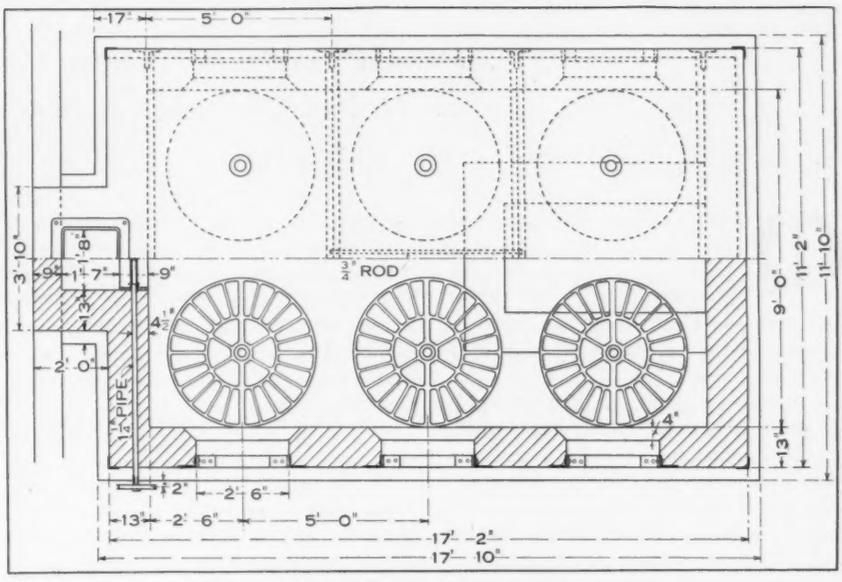


FIG. 2—PLAN OF REEL TYPE CORE OVEN

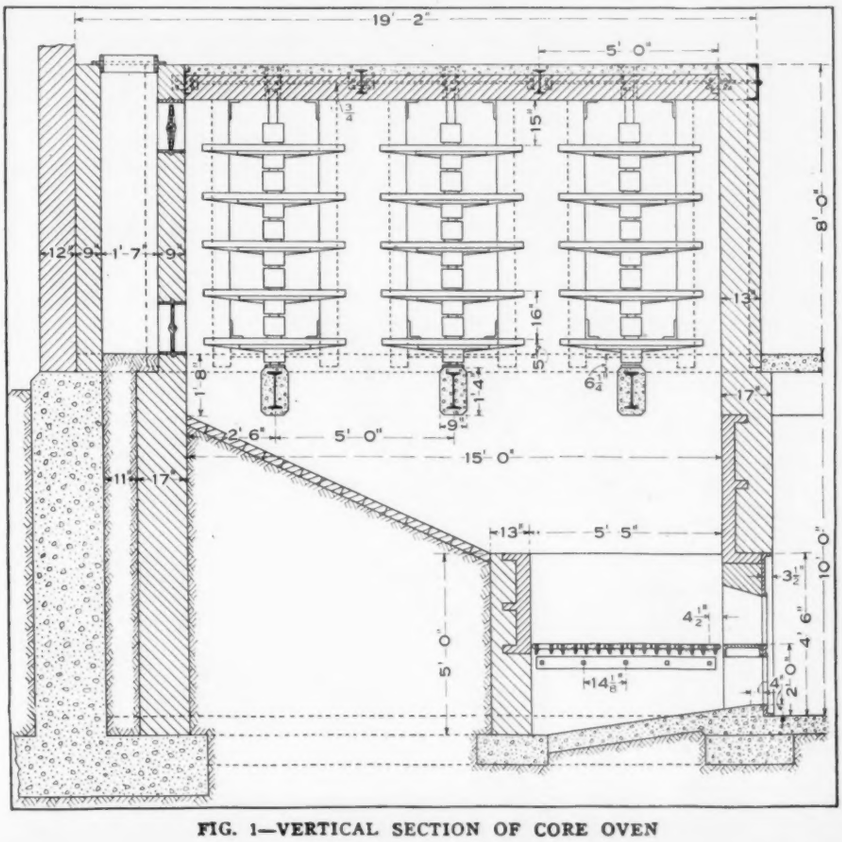


FIG. 1—VERTICAL SECTION OF CORE OVEN

The fire box is 2 feet, 11 inches wide and 5 feet, 5 inches long, giving a grate area of 15.8 square feet. A Case rocking grate similar to those installed in Case steam traction engines is employed. The ash pit is of ample size, being 1 foot, 4 inches deep at the front end and 2 feet at the rear. The gases escape from the ovens through two damper controlled flues, each 16 inches in diameter. They lead to a 19 x 20-inch square uptake, on the top of which is mounted an 18-inch steel stack.

Coleman Foundry Equipment Co.

The Coleman Foundry Equipment Co., 2102 Abbey avenue, Cleveland, recently organized, will engage in the manufacture of ovens, brass furnaces, aluminum furnaces and other equipment formerly built by the J. D. Smith Foundry Supply Co. The Coleman company purchased the patterns, patents and drawings formerly owned by the Smith company. The officers of the Coleman Foundry Equipment Co. follow: F A. Coleman, president; D. S. Hawkins, vice president, and C. H. Frank, secretary and treasurer. These officers formerly occupied similar positions with the J. D. Smith Foundry Supply Co.

Making Pipe Pattern and Core Box in Plaster

An English Foundryman Describes How This Material is Used to Advantage in Shops Abroad

By D. Gordon

MANY ways and methods are devised for producing pipe bend castings, the chief consideration in the majority of cases being extreme economy, as the number of castings required is invariably small.

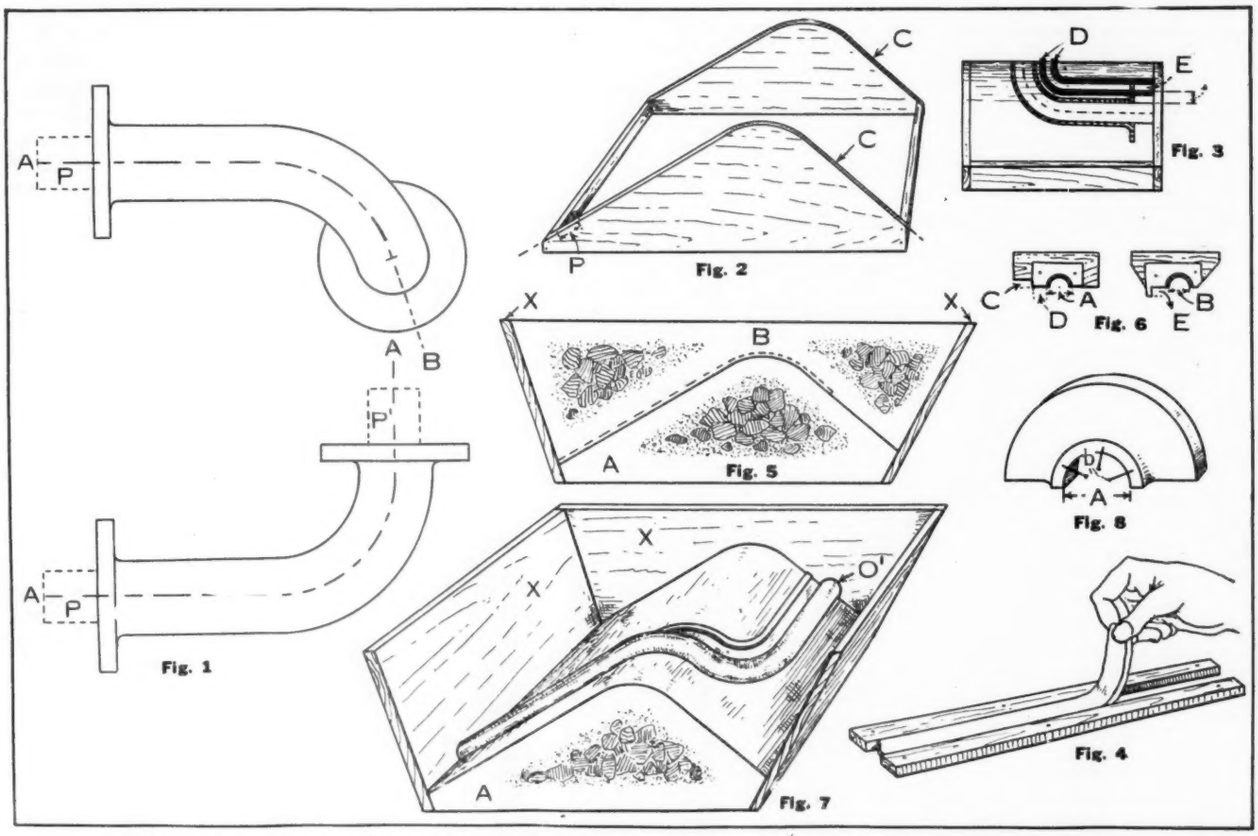
The pattern costs, as they obviously affect the casting cost, are reduced to the minimum and only in extreme cases does one find that a full pattern and its core box is supplied. The usual methods adopted for producing this class of casting is to utilize a skeleton pattern and strickle up the core by means of a guide and template, or by the direct method of first strickling up the core and parting its surface, the flanges being attached to the loam body. In some cases the pattern is strickled in plaster of Paris, the procedure for the pattern's formation being the same as that in loam, its core being strickled-up by means of a guide plate or bent rod. Further, when the pipe bend is of varying dimensions, the mold—made by means of a skeleton pattern—is layered over with a loam thickness and within this the core is formed. These practices, when the pipe bends are regular and uniform, are in every sense efficient and only lack practicability in operation when their diameters are small and their sectional thickness low.

Compound Bends

In the case of compound bends the loam pattern generally is out of the question and a skeleton pattern is in all probability likely to prove more costly than one fully constructed. In cases of the smaller compound bends it is usually the pattern cost factor that tends for the main production of these in copper their production in this latter material being considerably more costly—intrinsically and otherwise—if pattern costs could be ignored.

In the present article a method for making the pattern and core box of a small, compound bend is explained, the method insuring the uniformity of any metal thickness required, and is capable of being extensively applied to any work of a similar character.

Fig. 1 gives the elevation and plan views of a compound pipe bend, the diameter of which is 1¼ inches and its metal thickness ⅛ inch. The pattern is conveniently required in halves its joint following out the most desirable molding joint that can be obtained. A pattern block is made following the center line, *A-B*, in the elevation and *A-A* in the plan. To make this block a box, Fig. 2, is made, its upper edges, *C-C* following the contour of the center line, *A-B*, of Fig. 1, allowing for the print, *P*, length. In its width the print, *P* is allowed for, and is slightly in excess of the overall dimensions of the pipe. Within this box plaster of Paris is poured, centrally being bedded up with coke and sand, which are used to reduce the weight and incidentally the cost of the block. This plaster is struck level with the edges, *C-C*, and after hard-setting, the pipe, with print allowance, is set out, the center line



FIGS. 1 TO 8.—MAKING A COMPOUND PIPE BEND PATTERN AND CORE BOX IN PLASTER OF PARIS

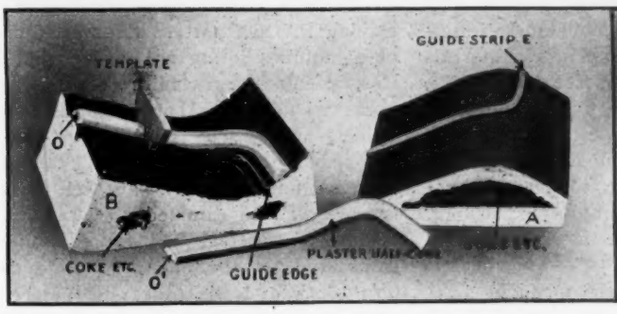


FIG. 9.—ONE PLASTER HALF CORE SHOWN UPON PATTERN BLOCK, *B*

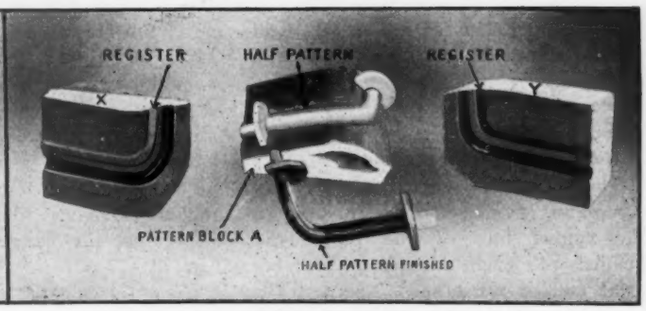


FIG. 10.—THE PLASTER CORE BOX, VALVES *X-Y* WITH ONE-HALF PATTERN UPON PATTERN BLOCK *A*. THE OTHER HALF IS FINISHED

being clearly scribed upon the surface. Following the contour of the pipe and the prints, a guide piece, *E*, Fig. 3, is formed, being about ½ inch away from the external diameter. This guide piece, which is the strickle guide, in thickness need not be more than ¼ inch and is formed by an addition of plaster to the pattern block. This addition is made by running fresh plaster between two strips of plasticine, *D*, Fig. 3, which follow the contour of the pipe along one edge, the other being of any convenient width.

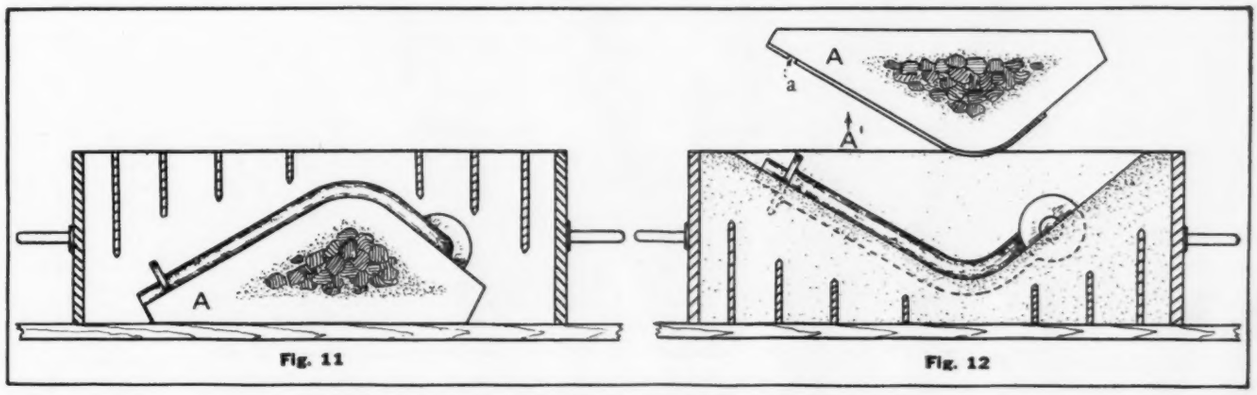
To make these plasticine strips, two pieces of wood, the required guide thickness, are nailed down to a board, their width apart being the desired width of the guide strip. Between these strips the plasticine is bedded and struck level with the wood strip surfaces, being then lifted and withdrawn, as shown in Fig. 4.

This block is next varnished to prevent the plaster from absorbing the oil with which the block is coated after the varnish has set. To form the pattern block for the other half pattern, the pattern block, *A*, is placed within a roughly formed wood box, *X*, Fig. 5, and over the block, *A*, plaster is poured, the box, *X*, height being sufficient to allow the desired thickness. This block, *B*, is also bedded-up with coke and sand, as in the previous example, and after the plaster has "set", the box is removed, the blocks *A* and *B*, being then separated, owing to the parting action of the oil, the last formed block being then varnished upon its point. Half cores, in plaster, are struck-up upon these blocks by means of the strickles, these working along their respective guide strips and striking up the plaster which is carefully poured upon the blocks until it conforms to the strickle striking edge.

These strickles should be formed from zinc plates for the strickling edges and backed up with wood to insure stability, and also to give a greater bearing surface for the bearing edges. The zinc plates will be found to give a smooth and clean surface to the plaster.

As will be noted, these strickles are made to suit the guide strips which in the one case project (*A*, Fig. 9), and in the other being recessed below the pattern block surfaces. The width, *D*, Fig. 6, is the distance from the guide edge to the pattern's exterior, and the strickles should be marked and cut out together in the first instance to the diameter, *B*, the core diameter, at the same time having the sectional metal thickness, *A*, clearly defined, the same strickles being utilized for striking-up the body of the pattern. In Fig. 9, these plaster half cores, *O-O*, with the pattern blocks, *A-B*, are shown, the removal of the cores from the blocks being obtained by means of a steady jarring action upon the latter. Pattern block *A* is again reoiled and returned to its former position within the box, *X*, and the plaster half core, *O*, varnished and oiled, is placed upon it, as shown in Fig. 7. Plaster is now poured within the box covering the block and core, and at its heavy positions it is lightened as formerly by coke and sand. When this has set the box is removed; thus one-half of the core box, *Y*, Fig. 10, is made. This box is well varnished upon its surfaces; being body-varnished along the core making surface, and after setting, the half plaster core that formed it is reset into position, the entire surface oiled and surrounded by the box, *X*. The remaining half core is placed over in its relative position to the reset half core, within the first made plaster core box, and is entirely covered with plaster. Thus, when set and removed, it makes the other half core box, *X*, after its plaster half core has been removed, Fig. 10. The guide strips act as registers for defining position and therefore no dowels for this purpose are necessary.

To make the pattern, two flanges split centrally and dowelled together are attached at their position upon the pattern blocks, *A* and *B*, the guide strip (as at *A*, Fig. 12,) being cut away so that the flange joints are lineable with the block joints. These flanges should be turned with their



FIGS. 11 AND 12.—METHOD OF MOLDING THE PIPE BEND

fillets and bored out (*A*, Fig. 8,) slightly less than the core print diameter. By means of projecting nails, *b*, bent toward the center, a firm means of attaching them to the plaster body of the pattern is obtained.

The prints at each end are first struck-up, a piece of wire bent to the center line of the pipe being bedded into each, extending from one print end to the other. The strickles are now recut as rapidly as possible to the pattern diameter, the body of which is formed from flange fillet to flange fillet in a similar manner to the making of the plaster core. In some cases it may be advisable to make strickles for both pattern and core, the latter being obviously necessary for the core prints, but this should be avoided, as far as possible, as it is much better to use the same strickles to prevent error. The half patterns, when removed from the blocks should be cut to shape where the strickles are limited for working, as against the flange faces, shown in Fig. 10.

To mold this pattern made in plaster, the pattern block, *A*, is placed upon the pattern board and one-half of the pattern is assembled upon it. The flask is now placed over the pattern, Fig. 11, rammed up and when evicted, the bock is withdrawn in the direction of the arrow *A*, Fig. 12, leaving the half pattern rammed. Suitable molding joints are made around this, at the flanges false cores being necessary for removal purposes. The remaining half pattern is now placed over the bedded-in half pattern—the flange dowels defining position—another flask is set over and rammed up. In both instances a perfect bed for ramming is assured, in the one case the pattern block and the other the pattern joint surface, the latter being, of course, supported by the sand. Their removal from the sand is by means of the dowel pins for one-half and a screw lifter fixed into the dowel eyes of the others, the rapping in each case being also at these positions.

Economy in Production of Miscellaneous Work

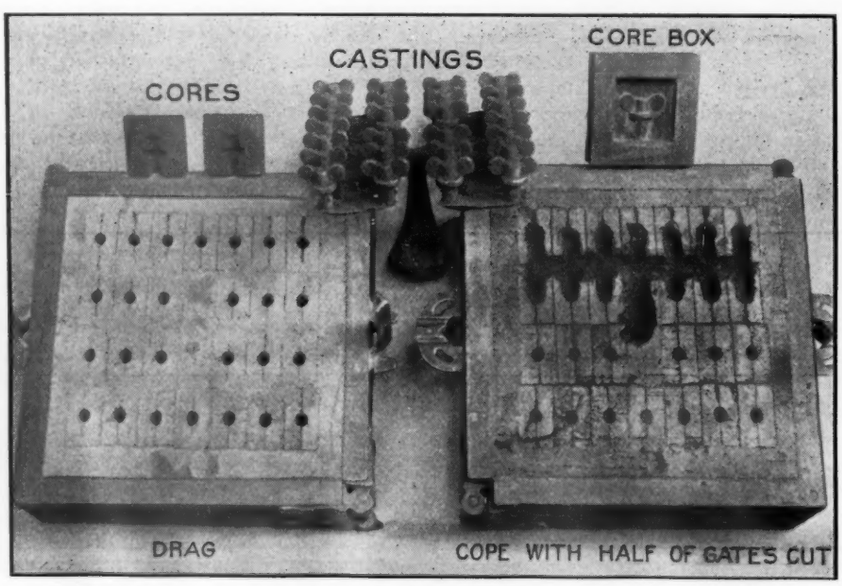
By J C Pendleton and R E Kennedy

EVERY foundryman is directly concerned with the question of efficiency, regardless of the methods he follows, or his attitude of mind toward the principles of modern foundry management. He cannot dodge the issue raised by efficiency, because out of all his competitors there will be a number, progressive enough to swing in with the trend of times toward efficient management. These latter will set costs of production and selling prices, which are unavoidably below those of shops under ordinary management. The time has come when economical production is a requisite in successful competition and it will not be long before efficient management becomes essential to existence. The burden of economy in production rests upon executive staff and efficiency must begin there. From the time an order is entered on the books until the finished part is delivered, the effect of efficient executive control must be felt. It has been quite customary in the average foundry to turn orders loose in the plant without any particular attention from anyone to see if the proper methods for that one job are employed.

Needless to say this practice does not produce economical results, yet it continues to be used by altogether too large a percentage of foundries in operation today. Time spent in analyzing each job as it comes in and deciding upon the most economical methods of production will return savings many times in excess of the initial cost of planning.

It is the purpose of this article to show how a little thought on the receipt of an order resulted in a very superior method of production which would not have been employed under the old system of foundry production. Upon the receipt of an order for a number of castings the average foundryman will give some consideration to the weight and design of the casting. If it is not of usual construction it is sent directly to the pattern shop, with attached sketches or blue-prints, with orders to make a pattern or number of patterns as is deemed best. On the other hand, if the casting is of intricate form or very heavy, the superintendent, foundry foreman and pattern shop foreman hold consultation to devise the most efficient way to make it.

Undoubtedly some of the castings are made in the easiest manner under this policy, but a varying percentage are not and it is these which retard production and cut down profits. The superintendent who allows any order to pass through his shop without some serious thought, no matter how small or large the number, is making an expensive mistake. Information relative to completed work in respect to methods and costs should be carefully preserved and ar-



BRASS BUTTERFLY NUT CASTINGS, SHOWING THE MOLD IN WHICH THEY WERE MADE

ranged in form for reference. These data in the hands of skilled foundrymen will enable close estimates on costs and time for producing new work. Instead of the all too common method of handling work in the routine manner without the adequate study of the undivided characteristics of every job, each order should go to an expert estimator who will decide upon the proper manufacturing methods, considering (A) design, and (B) how many castings to be made, (C) the date wanted, and (D) repetition order or not. After receiving expert analyses on these lines, there is some certainty that the order will go through the shop in an economical manner.

Rush Order

A few weeks ago a rush order was received in one foundry for 52 butterfly nuts to be cast in brass. The nut, as illustrated, is a very ordinary looking casting, and I venture to say that, if the average foundryman had received this order, he would have sent it to the pattern shop without any thought as to the cheapest way to make it, taking for granted that hurry-up methods in patternshop and foundry would be the factors employed to get the order out on schedule time. As to the number of patterns made, the foreman probably would have ordered more than one; that would depend on the shop. For instance, a shop having a continuous run on brass castings would probably require one pattern, and it placed in a mold with other patterns, but this means time spent in cutting partings, gatings, swabbing and drawing pattern. It is not an easy matter to secure uniform results on small patterns which have to have a spike driven in and rapped.

If more than one pattern would seem necessary, the cost would have been high, making it necessary to charge a prohibitive price for the job.

In one shop a careful analysis is made of every order received and in this case it was decided to cast the entire 52 pieces in two molds, 26 in each mold made by a combination core and green sand molding process, involving a half pattern in the form of a corebox and 104 cores. The various steps in the process are given in order with the time required:

1.—Pattern made as a corebox, one-half of pattern only as shown in the illustration. Time to complete, 2.25 hours.

2.—Coremaking by usual method, time required, 0.50 hour.

3.—Molding was accomplished in 0.66 hour by methods described in detail hereafter.

4.—Time required to bake cores, 0.50 hour.

5.—Casting, shaking-out, and cleaning ready for delivery, 0.55 hour.

Total time upon receipt of order to delivery of casting, 4.46 hours.

All of the castings came out clean and sound and in record time in comparison with that required by the usual methods. Obviously the cost of production was low as the time of skilled labor was reduced to the minimum and no expensive material was employed.

How the Mold was Made

The mold was made as follows: The cores were made from brass molding sand, using flour as a bond, and dried; they then were placed inside of the drag and matched to form the casting and to prevent shifted partings. They were also placed in best position for grating. The drag was then rammed and rolled over.

The cope was rammed on a molding board with sprue pin in the center. The drag was then dusted with parting dust, the cope placed on and rammed slightly with the butt rammer; this caused the dust to adhere to the cope, showing the location of the gates. The accompanying illustration shows half of the gates cut in the cope.

This method of producing small castings in small lots can be employed with profit by foundrymen who have calls for work of this nature, as it gives clean castings at a low cost with the regular equipment and working forces.

Making the Foundry Pay

After reading your valuable paper with keen interest for a number of years, and seeing many questions asked and many answered, as to how a foundry could be run successfully on a profit paying basis, I have always thought and do so yet, that no man ought to place himself or seek after such a responsible position as foundry foreman until he himself is in a position practically to take off his coat and make what he is demanding from men placed under him. When he is able to do so, he is then able to take men and boys by the hand and lead them, because if you can make the jobs yourself you can teach others, and those you do not need to teach, you know what you ought to get from them.

In 20 years of almost constant traveling from one shop to another and from city to city, I have found, as a general rule, that educated men have the preference. Education is a grand thing for any man, but in the foundry business so many different things can go wrong even though one takes the greatest care to prevent accidents.

I believe that the man who runs the foundry should have business instinct, just as keen as his employer. He will then be a success. He can't be otherwise, because the business man will spend a dollar to make five any day, or is ready to take a chance. Therefore, it behooves the foundry foreman to study how by systematizing his shop, he can get the most out of his men without necessarily driving them. Instead of having molders running around the shop looking for clamps, nails and gaggers, make the helpers place things where they ought to be and then when a molder needs a certain length of gagger or clamp, he just puts his hand on them. No time is lost. The molder is happier because he is getting on with his work. The foreman is happier, as he sees a larger output.

Knowing the Cupola

I also believe that in many cases the employer could find in his foundry, in the sand heap, better and abler men to run his foundry for him than some he generally employs. Of course, a good deal can be done with a little education, such as mixing iron by analysis and having a thorough knowledge of the cupola. For instance, a question was asked and answered in the April issue of THE FOUNDRY by a foundryman who wants 30 minutes for his iron to come down after he puts on the blast. His cupola was lined to 31 inches, with tuyeres 8 x 9 inches, which, according to tuyere area, ought to be in a 48-inch cupola. Under such conditions, is it any wonder that foundry employers complain that they can't make their foundry pay? In that foundry alone 500 pounds of coke was thrown away every time the cupola was operated.

J. EDWARDS, San Francisco.

Manfecual--A New Alloy

A new alloy, known by the trade name of "Manfecual" is being placed on the market by the Iron and Steelworks Mark, Wengern-Ruhr, Germany. This alloy consists of copper, 55 per cent; iron, 15 per cent; manganese, 28 per cent, and aluminum, 2 per cent. It will be noted that this alloy contains an unusually large percentage of iron and is used in the manufacture of bronze. In making bronze, the copper is melted first, after which about 1 per cent of aluminum is added, and then the alloy, in the amount required, is added to the mixture.

This alloy is already in use extensively abroad, a number of large ship building firms employing it in the manufacture of manganese bronze castings.

Discussion of Rapid Nickel Solutions

By Seymour W Rowsbar

WHENEVER two or more electroplaters converse upon topics relating to plating, the conversation almost invariably includes a variety of questions and remarks with reference to the most important modern improvement in the electro-deposition of nickel-rapid nickel salts. In a majority of cases, where the speakers are those who have only the information given by the promoter to judge by, skepticism is evidenced by the ridiculous opinions, which in many cases are based upon merely a fancy which has taken root while the plater has been neglecting the theory of chemistry and electricity. If asked for a logical reason for his anti-rapid salt views, he is simply sure that the product is either a German or French fraud and the sensation will soon blow over.

From our investigations in different parts of the country we are confident that 95 per cent of the trial orders issued by firms for these salts are the result of interest taken in the material by managers or superintendents of manufacturing plants which include plating in the list of operations upon a class of goods which are sold at small profit, or where the plating department has failed to process the work rapidly enough during rush seasons. In very few cases has the plater encouraged such trials and seldom has he taken the initiatory steps to obtain the salts. There appears to be one very potent reason for a large amount of this skepticism among platers who have not kept up with the progress made in the technical education of the plater during the past few years. We make no pretense to decide whether the influence thus brought to bear upon the plater is justified or not, but personally believe that it is the natural result of being once fleeced.

Our readers will remember the remarkable claims made for a product called red copper compound, which made its appearance some years ago and created considerable interest among platers for a brief period. The material was introduced by a well-known firm of chemists and then the market was soon flooded with numerous brands of the compound, each maker claiming the use of the compound would revolutionize the process of copper, brass and bronze plating in cyanide baths. How successful the attempts to supplant the time-tried carbonate of copper proved may be judged by casual mention of the copper compound to a few platers in different localities. Some will show a quantity still in stock (now useless); others will greet the reference with a volley of condemnatory expletives or an attitude of indifference which is assurance that they are not advocates of red copper compound solutions. With the memory of the compound still fresh, these men are prone to regard any decided change in the composition of a plating solution, as proclaimed by a supply house or more especially a foreign representative of an unknown promoter, as being a humbug. We are constantly being annoyed by some quack, and all honor is due those who prefer to go slow rather than be first in the field.

Rust-Proof Nickel Coatings

During the past four or five years we have received by mail several pamphlets describing certain salts for making solutions to produce rust-proof coatings of nickel and zinc. These pamphlets have been sent apparently by several different companies, but we noticed they all came from one city and a careful perusal led us to believe they were all of the same origin. Recently, one of these was received in which the writer stated he would prepare the solution and teach the plater how to operate it and if we were satisfied he would give us the formula if we would place $500 in a bank payable to him when the solutions did what was claimed for them.

We now have positive evidence that this is only the latest chapter in the persistent career of "a plater with a secret" and find his personality mixed up with the aforementioned pamphlets. After this investigation and the facts produced by others, we have no hesitancy in branding the whole business as "bunco" with a big *B*. Such experiences undoubtedly have a tendency to retard the introduction of rapid nickel salts while prejudice prevents many from investigating the claims made for any new chemical mixture for increasing efficiency in the plating room. To these doubting platers I wish to say that the rapid nickel salts have already endured a longer life than would be possible were they a delusion and a snare. The commercial introduction of the rapid nickel salts began some six or eight years ago in Europe and the manufacturers were then slow in accepting the innovation. In less than 18 months, however, the markets of European countries were flooded with numerous brands of rapid nickel salts and the platers and manufacturing firms began to take notice and were so favorably impressed that no surplus stock of ordinary nickel salt was ordered. As in America, there were several important points to study and a careful note made of whether the product was suitable for individual requirements. Today, nearly every reputable supply house in

England, Germany and France has its own particular trade name for a rapid nickel salt and the advent of these salts has been received with favor, and repeat orders wherever once installed. In America we have on the market at least six or eight well advertised brands and no doubt all have some merit, while it is quite possible that some are superior to others. In fact, we have demonstrated this satisfactorily upon several occasions.

Salt, Low in Metal

That all are not adapted to all conditions is also an admitted fact as there is a very decided variation in their composition, some containing a very high percentage of conducting salts, such as sodium chloride or ammonium sulphate and are used at comparatively low density while others contain a higher percentage of metal and less conducting salts. Our experience with the various brands permits us to venture the recommendation of the salt low in metal and rich in conducting salts for work with projections or indentations while the salts with higher percentage of metal and low content of conducting salts will prove efficient with work of more uniform shape.

One solution which has created considerable interest throughout America and is of German origin is used at a density of 16 degrees Beaume and has a beautiful, clear, emerald green color. An analysis of this salt has been obtained by the writer from several sources and thus far we have failed to get two to correspond in any particular with reference to percentages. We mentioned the fact to a representative of the importer and he contended that a correct analysis of the salt was impossible, and in an endeavor to interrupt our interrogations he remarked that the chemist's analysis of the white of an egg and the venom of a snake were identical. Just imagine the feeling of awe which would possess many platers when told this by a glib salesman. Then fancy the respect the same platers would have at a later date for the chemist who could not distinguish the difference between the two fluids. The remark is truth so far as similarity is concerned, but no farther. The white of an egg and the venom of a snake both contain carbon, hydrogen, nitrogen and oxygen, but the snake's venom also contains a peculiar principle called echidnine or viperine, which is the active poisonous matter, and the important active principles contained in the rapid nickel salts are now or will be known by those who persevere in the search for knowledge. Do not allow anyone to gain your respect by any such comparisons. In short, do not let any mysterious story told by slick strangers interrupt your advancement toward the goal you may be striving to reach.

Every formula which we have seen for nickel salts includes nickel sulphate as the source of metal and many include ammonium chloride. Our attention has been directed to the possibility of this determination being wrong and that the formula should be nickel chloride and ammonium sulphate for the reason that while a quantity of pure double nickel salts dehydrated by use of alcohol shows an emerald green color, the imported German nickel salt, when dehydrated in the same manner, shows a yellowish green color characteristic of nickel chloride. But this we attribute to the presence of sodium chloride in the nickel salt as may be demonstrated by adding a small percentage of sodium chloride to a solution of pure double nickel salts and dehydrating with alcohol, when the same yellowish green color will be obtained.

The presence of boracic acid in any nickel salt may be detected by a very simple test which any plater may perform in a few minutes. Place the dry salts upon a watch glass, or any clean glass, and moisten with pure grain alcohol. Then set fire to the alcohol; if a green flame is produced, the salt contains boracic acid. If a solution is to be tested, dehydrate the salts, dry and proceed as above. Boracic acid will be found in nearly all rapid nickel salts, and if not present, the plater usually finds it an advantage to add a small amount. Objections to dense solutions are sometimes based on the experience of some plater who has tried a small sample of the salts and produced pitted work and since the introduction of dense solutions, some experimenters have taken advantage of this tendency toward pitting to attribute the cause in the double sulphate solution to exactly the reverse condition recognized as the cause heretofore, namely concentration.

Tests Made

Our experience does not substantiate this contention. When we prepared our first rapid nickel solution which was made from the German salt, we equipped the bath with new 97 per cent nickel anodes and electrolyzed the bath with direct connection to buss bars for 20 hours. Then we plated 30 square feet of steel parts, using 310 amperes at 3½ volts. The parts hung perpendicular in the bath and were of flat sheet steel. The deposit was good. Next we plated 20 square feet surface of brass castings, using 250 amperes at 3½ volts. The deposit was badly pitted and the same result followed the next two or three trials. Then we tried regulating the ampere flow so that only 10 amperes or less per square foot was used and the deposit was satisfactory. The current was carefully regulated for a few days and no pitting obtained. Then the current was increased slowly for each batch of work until we noticed that the pitting did not occur under any circumstance and we have since seen no indication of the trouble. We have experienced pitting in double salt solution when the baths were rich in metal and acid, also when poor in metal and alkaline, and in various other conditions, and we are yet to be convinced that dense solutions encourage pitting, unless very poor in conducting properties.

Acidity of Rapid Nickel Solutions

One feature of rapid nickel solutions, which is more or less pronounced, is the acidity. An acid solution certainly is more efficient and the anode efficiency is greater than in alkaline solutions. Most platers are aware that it is impossible to make a concentrated solution from double nickel salts and use it in that condition. Two ounces of metallic nickel per gallon would be a fair solution when freshly made and at working temperature, but in some of the rapid solutions we have more than twice that amount and an analysis of the salt shows a percentage of about 54.88 nickel sulphate. Naturally, with this amount of nickel, the efficiency question, insofar as the solution is concerned, is easily solved, as there is decidedly less waste of current in decomposition of water and ammonium. The double salt solution liberates more hydrogen than the rapid solutions we have used and hydrogen cannot be set free without the loss of nickel, therefore more hydrogen and less nickel. An anode efficiency of 90 per cent is about the limit with double salts, while with the rapid salts, the anode efficiency will average 98 per cent. The proper anode for use with the rapid nickel solutions, or in fact any other nickel solution, is one of at least 96 per cent nickel or higher, if they can be obtained. There is economy in this as a good anode of 96 or 98 per cent nickel does not become spongy while in the solution, and spongy

anodes are of little value in a busy plating room.

If the supply houses would cast and solicit the sale of 98 per cent nickel anodes, it would not be many months before 75 per cent of the platers would be using them, but the anode maker has never, neither does he now, encourage the sale of 98 per cent nickel anodes simply because he has difficulty in making them and there is better profit in those containing iron and tin. It is not that there is any superiority in the 90 to 92 per cent nickel anode for they are merely relics of the old days when nickel solutions were operated in an alkaline condition with a weak current and the iron found its way to the bottom of the tank in the form of iron oxide. With an acid solution, the iron is held in suspension longer and is more or less liable to be deposited along with the nickel.

To test the deposit for iron, take a strip of nickel deposited in a solution containing iron and dissolve it in C. P. nitric acid in a test tube over a bunsen flame. Dilute with water and the iron may be precipitated as iron oxide by adding ammonia in the presence of an excess of ammonium chloride. Many of the rapid salt promoters claim a gain of from two-thirds to three-fourths in output by the use of rapid salts. We would not hesitate to say the output can be doubled and at reduced cost, especially if plant is being newly equipped, as the double sulphate solution would require twice the number of tanks and fittings that the rapid solution would need for same output and because of superior anode efficiency the upkeep would be less.

Initial Cost

The installation or initial cost of rapid nickel salt solutions is high and we can see no chance for a reduction in labor costs except it be less work in solution maintenance, but when all things are considered, such as power, floor space, time, etc., we are convinced the rapid salts is a good investment if the correct salt is obtained. One automobile firm in New York state nickel-plated 70 per cent of its output in 22 tanks of double nickel salt solution, but was obliged to run 24 hours per day. After installing the rapid nickel solutions the following season, the same firm nickel-plated 90 per cent of its output (which was greater than the previous year) in 22 tanks working nine hours per day. In this case, the saving was in labor, time and power.

When selecting a rapid nickel salt or choosing a formula for the solution, it is good policy to consider the prospects of making additions in the shape of metallic salts in order to maintain a uniform condition. Some require replenishing quite frequently, while others will remain constant for almost an indefinite period with consistent management. A solution composed of 24 ounces of sulphate of nickel, 5 ounces of boracic acid and 1½ ounces of sodium chloride to each gallon of water will deposit a durable, non-porous coating in a much shorter time than the ordinary double salt solution. The deposit is easily buffed and is of splendid color, but the solution requires constant, careful attention to avoid an exhausted condition; results may be obtained with a pure nickel anode in this solution. The anode efficiency is nevertheless low and while some claim the maintenance costs are considerably less than the double salt solution, we doubt it, as it is possible to operate a double salt solution continuously with no other additions than neutralizing and conducting chemicals if the anode surface is of proper proportion.

Saving in Buffing Cost

There will be a saving in the buffing department when using the single salt solution, as the deposit is easier to finish and hence less material will be required, such as buffs, coloring compound, etc. The use of 98 per cent nickel anodes and pure salts enables the plater to keep clean solutions. The absence of slime is very noticeable, the anodes remaining comparatively clean and the solution free from iron oxide in annoying quantities. To those who have not tried a high speed nickel solution, we commend those with high percentage of metal and only a moderate amount of chlorides, and if all steel work is copper-plated before nickeling, the results will be highly satisfactory even when subjected to severe atmospheric tests, while for all brass goods, the rapid nickel solution is truly a boon to the plater.

August Meeting of Southern Michigan Foundrymen

The next monthly meeting of the Southern Michigan Foundry Foremen's Association will be held at Kalamazoo, Mich, Aug. 29. All foundrymen in the southern part of the state are invited to attend. This branch of the Associated Foundry Foremen holds monthly meetings for the discussion of problems relating to foundry practice. S. A. Schaeffer, 1116 Summit avenue, Kalamazoo, is secretary-treasurer.

Polishing Aluminum Castings

Will you kindly advise me how to polish aluminum castings, such as kitchen utensils, etc.?

When polishing aluminum it is advisable to avoid the use of coarse abrasives if possible, as they drag or pull the metal and render the surface difficult to finish. If, however, the castings are quite rough, first polish with No. 70 emery, then grease on No. 120 emery with a compressed canvas wheel and follow with No. 160 emery on a felt wheel; then impart the final luster by buffing, using a good grade of white polish on a stitched cotton wheel. If the castings are not rough the treatment with No. 70 emery may be dispensed with and the castings finished on No. 120, followed by No. 160 emery and buffed.

Polishing Simple Castings

If the castings are of simple pattern, the polishing may be accomplished by almost entirely tumbling. If rough, use coarse sand or crushed granite to produce a uniform surface; this treatement may appear too harsh, but owing to the peculiar nature of the metal it requires a sharp abrasive for roughing in a tumbler. The sand or granite is used wet, about the consistency of thin mortar. When sufficiently roughed, the castings are washed and transferred to a wooden or wood-lined tumbling barrel and tumbled with steel balls or smooth steel punchings in water containing ¼ ounce oxalic acid to the gallon. This treatment requires from two hours to two days, depending on the shape and condition of the castings and the speed of the barrel, the proper speed being just sufficient to cause the load to roll and not to jump across the barrel. When properly tumbled in this manner and finished on a buff wheel as previously stated, the finish is equal to and in many cases superior to a wheel polish and the cost of production is decidedly less as many hundred pieces can be treated at one time. But little labor is required and a boy can soon be taught to load and unload the tumblers. Naturally, if the utensils are large and thin, or hollow, the wheel treatment must be employed.

High-Lead Bearing Metal Problem

In an article entitled "The High-Lead Bearing Metal Problem," published in the June issue of THE FOUNDRY, page 219, the ferro-manganese content was given as 3 per cent whereas it should have been 0.5 per cent. In each case the copper content should have been increased proportionately.

Effects of Vanadium on Properties of Pig Iron

Results of an Interesting Series of Tests Which Show That Strength and Machining Qualities are Increased by This Alloy

By Edwin O Fitch Jr

THE following tests which were made under the writer's supervision at Lafayette College were for the purpose of determining the characteristics of five commercial grades of foundry pig iron manufactured by The Thomas Iron Co., Easton, Pa. Three of the samples were from the furnaces of the company at Hokendauqua, Pa., and the other two specimens were from the Alburtis furnaces.

The tests dealt with the pure pig, without any addition of scrap, and are of interest in that they set forth the qualities of the iron itself. Later it is proposed to continue the tests, adding scrap in different proportions, and with different qualities of coke for the purpose of determining the best and most economical practice with these grades of pig iron.

A 35-inch Colliau type cupola installed in the foundry of the department of mechanical engineering at Lafayette College was used. Jamison 72-hour coke was employed in all the tests. No flux was used except in one heat, and then 15 pounds of oyster shells were charged with 598 pounds of pig and 300 pounds of coke.

The molds for casting the test bars were very carefully made, and the bars were gated in pairs, with risers. Core sand strainers were inserted at the base of the pouring basins to preclude any possibility of slag or dirt entering the mold after careful skimming. After pouring, the bars were allowed to remain in the sand until cool. The patterns were marked to indicate the first, middle and last parts of the heat.

Large Coke Bed Necessary

In all five tests, approximately 600 pounds of pig were used per heat, and it was necessary to use a coke bed of from 300 to 350 pounds to bring the metal to the proper height in the cupola. This gives a larger fuel ratio than would obtain in commercial practice. The shrinkage was taken over the average of each heat and was determined with the greatest possible precision.

The tensile and transverse specimens used in determining the strength of the metal were of the standard form, the tensile specimens being 0.8 inch in diameter and the transverse specimens 1 x 2 inches square, 24 inches between supports. These specimens were selected from three parts of the heat and were tested in the general testing laboratory of Lafayette College. The average strength of three specimens from each heat was determined.

The modulus of rupture given in the summary of tests which follows is the computed extreme fiber stress at the time of rupture. It is not the true fiber stress, as the formula employed does not apply beyond the elastic limit of the material.

Let S equal modulus of rupture in pounds per square inch
M equal maximum bending moment
I equal moment of inertia of cross-sectional area about neutral axis
c equal distance from neutral axis to extreme fibre
then according to the well known principles of mechanics,

$$S = M\frac{c}{I}$$

Let P equal ultimate load
l equal span (24-inch)
b equal width of specimen
d equal depth of specimen
then $M = \frac{1}{4}Pl.$

$$c = \frac{d}{2}$$

$$I = \frac{1}{12}\,bd^3$$

and $$S = \frac{1}{4}P.24.\frac{\frac{d}{2}}{\frac{1}{12}.bd^3}, = \frac{36\,P}{db^2}$$

Photomicrographs and photographs of fractures were made in the metallurgical department of the college. Chemical analyses of material were made by chemists of The Thomas Iron Co., and by Dr. Porter W. Shimer, Easton, Pa.

Summaries showing the important facts gathered from the series of five tests are given below. I have included all the data obtained during the strength tests in order that it may bring out emphatically the uniformity of the strengths of the specimens selected for the tests.

Test of No. 2 Plain, Cast No. 600 from Alburtis Furnace, Mark 600-A

The iron was made from a mixture containing 49 per cent Richard ore, from the mines of The Thomas Iron Co., at Wharton, N. J., and 51 per cent local ores. The cupola charge consisted of 598 pounds of pig, 300 pounds of coke and 15 pounds of oyster shells. The analyses of the pig and the castings are as follows:

	In pig.	In castings.
Silicon	1.90	1.692
Sulphur	0.04	0.036
Phosphorus	0.688	0.752
Manganese	0.94	0.837
Ti.	0.209	0.141
Vanadium	0.046	0.046
Carbon	3.52	3.46

The analysis of the coke gave the following results: Moisture and volatile matter, 1.591 per cent; ash, 11.395 per cent; phosphorus, 0.014 per cent; fixed carbon, 87.013 per cent; sulphur, 0.851 per cent; silica, 6.340 per cent. In the cast from the cupola the metal was medium fluid. The average shrinkage was 0.0868 inch per foot. The result of the tensile tests are as follows:

Mark.	Mean diam., in.	Mean area, in.	Ultimate load, lbs.	Ultimate strength, lbs. per sq. in.
600-A-1	0.7949	0.4963	13,600	27,400
600-A-2	0.7974	0.4994	13,700	27,430
600-A-3	0.7960	0.4976	12,460	25,040
Average				26,620

The detailed results of the transverse tests are as follows:

Mark	Width, in.	Depth, in.	Ultimate load, lbs.	Modulus of rupture, lbs. per sq. in.
600-A-1	2.02	1.00	2,500	44,550
600-A-2	2.00	1.00	2,930	52,740
600-A-3	2.00	1.00	2,890	52,020
Average				49,770

Figs. 1, 2 and 3 were made from photomicrographs of castings from this iron, magnified 100 diameters. In Fig. 1, the specimen was etched to show the crystal grains of the metal to better advantage and the others were polished to display the graphite. The micrographs would indicate that the iron is remarkably sound and structurally uniform. Fig. 4 shows the fracture of one of the tensile specimens. It shows an iron of fine granular structure. This grade of iron is close grained, easy to machine and polishes fairly well. It seemed to be free from hard spots.

Test of No. 2 Plain, Cast No. 618, Alburtis Furnace, Mark 618-A

This pig was made from a mixture of 66 2/3 per cent Richard ore from The Thomas Iron Co.'s mine at Whar-

ton, N. J., and 33 1/3 per cent local ores. The charge to the cupola consisted of 630 pounds of pig and 350 pounds of coke. No flux was used. The analyses of the pig and castings are as follows:

	In pig.	In castings.
Silicon	1.93	1.881
Sulphur	0.026	0.044
Phosphorus	0.84	0.844
Manganese	0.26	0.386
Ti.	0.190	0.148
Vanadium	0.043	0.040
Carbon	3.41	3.42

The analysis of the coke resulted as follows: Moisture and volatile matter, 1.591 per cent; ash, 11.395 per cent; phosphorus, 0.014 per cent; fixed carbon, 87.013 per cent; sulphur, 0.851 per cent; silica, 6.340 per cent. In the cast from the cupola the metal was hot and fluid with considerable slag. It is believed that the introduction of some scrap would help this. The average shrinkage was 0.0822 inch per foot. The results of the tensile tests are as follows:

Mark.	Mean diam., in.	Mean area, in.	Ultimate load, lbs.	Ultimate strength, lbs. per sq. in.
618-A-1	0.7984	0.5006	8,850	17,680
618-A-2	0.7981	0.5003	8,850	17,690
618-A-3	0.7970	0.4989	9,650	19,340
Average				18,240

The following figures were obtained from the transverse tests:

Mark	Width, in.	Depth, in.	Ultimate load, lbs.	Modulus of rupture, lbs. per sq. in.
618-A-1	2.03	1.01	2,160	37,560
618-A-2	2.03	1.01	2,120	36,870
618-A-3	2.01	1.01	2,130	37,400
Average				37,280

Figs. 5, 6 and 7 indicate the character of the metal. These micrographs show that the metal is structurally uniform and sound. The fracture of one of the tensile specimens, Fig. 8, indicates a fine, granular gray iron. This iron was easy to machine and takes a fairly good polish.

Test of No. 1X Iron From Hokendauqua Furnace, Mark X-1-H

This pig was made from a mixture containing 25 per cent Richard ore from The Thomas Iron Co.'s mines at Wharton, N. J., and 75 per cent Lake, New York state and local ores. The charge to the cupola consisted of 604 pounds of pig and 350 pounds of coke. No flux was used.

The analyses of the pig and castings are as follows:

	In pig.	In castings.
Silicon	3.28	3.35
Sulphur	0.032	0.048
Phosphorus	0.760	0.736
Manganese	0.74	0.512
Ti.	0.272	0.135
Vanadium	0.041	0.038
Carbon	3.52	3.11

The analysis of the coke follows: Moisture and volatile matter, 1.591 per cent; ash, 11.395 per cent; phosphorus, 0.014 per cent; fixed carbon, 87.013 per cent; sulphur, 0.851 per cent; silica, 6.340 per cent. In the cast from the cupola the metal was hot and fluid and free from slag. The average shrinkage was 0.0822 inch per foot.

The tensile tests resulted as follows:

Mark.	Mean diam., in.	Mean area, in.	Ultimate load, lbs.	Ultimate strength, lbs. per sq. in.
X-1-H-1	0.7999	0.5025	10,820	21,530
X-1-H-2	0.7995	0.5020	10,650	21,220
X-1-H-3	0.8023	0.5056	11,780	23,300
Average				22,020

The transverse tests resulted as follows:

Mark	Width, in.	Depth, in.	Ultimate load, lbs.	Modulus of rupture, lbs. per sq. in.
X-1-H-1	2.03	1.01	2,120	36,870
X-1-H-2	2.06	1.01	2,190	37,540
X-1-H-3	2.02	1.00	2,260	40,270
Average				38,230

Specimen X-1-H-2 had a small blow hole about 3/8 x 1/8 inch, near the center of the section in the plane of rupture.

In the micrographs, Figs. 9, 10 and 11, specimen X-1-H-1 was etched to show the granular structure of the metal; the others are polished to show the graphite. These would indicate that the metal was uniform in structure and sound. The fracture of one of the tensile specimens is illustrated in Fig. 12. It shows a fine granular gray iron, which was easy to machine and had good polishing qualities. This iron is good for machinery castings, and from experience, I have found that with 40 per cent machinery scrap, this iron gives good results, and takes an excellent polish.

Test of No. 2X Iron From Hokendauqua Furnace, Mark X-2-H

This pig was made from a mixture of 29 per cent Richard ore from The Thomas Iron Co.'s mines at Wharton, N. J., and 71 per cent Lake, New York state and local ores. The cupola charge consisted of 588 pounds of pig and 350 pounds of coke. No flux was used.

The analyses of the pig and castings are as follows:

	In pig.	In castings.
Silicon	2.68	2.492
Sulphur	0.049	0.063
Phosphorus	0.896	0.876
Manganese	0.58	0.58
Ti.	0.226	0.154
Vanadium	0.043	0.040
Carbon	3.65	3.17

The analysis of the coke gave the following results: Moisture and volatile matter, 1.591 per cent; ash, 11.395 per cent; phosphorus, 0.014 per cent; fixed carbon, 87.013 per cent; sulphur, 0.851 per cent; silica, 6.340 per cent. In the cast from the cupola, the metal was hot and fluid and free from slag. The average shrinkage was 0.0868 inch per foot.

The tensile tests resulted as follows:

Mark.	Mean diam., in.	Mean area, in.	Ultimate load, lbs.	Ultimate strength, lbs. per sq. in.
X-2H-1	0.7947	0.4960	10,370	20,910
X-2H-2	0.7986	0.5010	10,150	20,260
X-2H-3	0.7971	0.4990	9,950	19,940
Average				20,370

The transverse tests resulted as follows:

Mark	Width, in.	Depth, in.	Ultimate load, lbs.	Modulus of rupture, lbs. per sq. in.
X-2H-1	2.01	1.01	2,210	38,810
X-2H-2	2.04	1.02	2,610	44,290
X-2H-3	2.04	1.02	2,600	44,980
Average				42,690

The micrographs, Figs. 13, 14 and 15, indicate that the metal was uniform in structure. The fracture of one of the tensile specimens, Fig. 16, shows a fine granular gray iron which was easy to machine, and had good polishing qualities.

Test of No. 3 Foundry Iron From Hokendauqua Furnace, Mark 3-H

This pig was made from a mixture of 29 per cent Richard ore from the mines of The Thomas Iron Co. at Wharton, N. J., and 71 per cent Lake, New York state and local ores. The cupola charge consisted of 636 pounds of pig and 350 pounds of coke. No flux was used. The analyses of the pig and the castings were as follows:

	In pig.	In castings.
Silicon	1.65	1.505
Sulphur	0.054	0.083
Phosphorus	0.776	0.780
Manganese	0.78	0.386
Ti.	0.172	0.097
Vanadium	0.044	0.038
Carbon	3.72	3.50

The analysis of the coke follows: Moisture and volatile matter, 1.591 per cent; ash, 11.395 per cent; phosphorus, 0.014 per cent; fixed carbon, 87.013 per cent; sulphur, 0.851 per cent; silica, 6.340 per cent. In the cast from the cupola the metal was hot, fluid and free from slag. The average shrinkage was 0.0959 inch per foot. The results of the tensile tests are as follows:

Mark	Mean diam., in.	Mean area, in.	Ultimate load, lbs.	Ultimate strength, lbs. per sq. in.
3-H-1	0.8013	0.5042	10,410	20,650
3-H-2	0.7991	0.5015	10,290	20,520
3-H-3	0.7990	0.5014	10,390	20,720
Average				20,630

The detailed results of the transverse tests are as follows:

Mark	Width, in.	Depth, in.	Ultimate load, lbs.	Modulus of rupture, lbs. per sq. in.
3-H-1	2.01	1.00	2,090	37,240
3-H-2	2.03	1.01	2,510	43,650
3-H-3	2.04	1.02	2,300	39,030
Average				39,970

In the micrographs, Figs. 17, 18 and

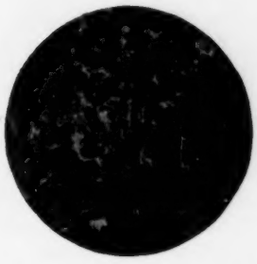


Fig. 1—Specimen No. 600-A-1

Fig. 2—Specimen No. 600-A-2

Fig. 3—Specimen No. 600-A-3

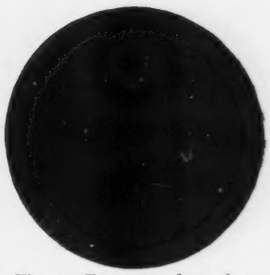


Fig. 4—Fracture of specimen No. 600-A-2

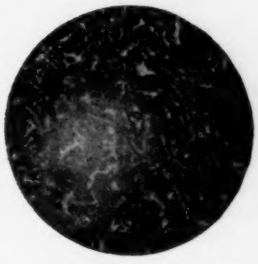


Fig. 5—Specimen No. 618-A-1

Fig. 6—Specimen No. 618-A-2

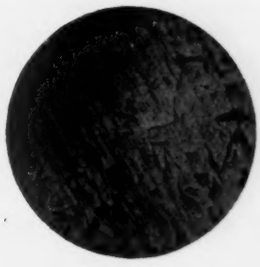


Fig. 7—Specimen No. 618-A-3

Fig. 8—Fracture of specimen No. 618-A-1

Fig. 9—Specimen No. X1-H-1

Fig. 10—Specimen No. X1-H-2

Fig. 11—Specimen No. X1-H-3

Fig. 12—Fracture of specimen No. X1-H-2

Fig. 13—Specimen No. X2-H-1

Fig. 14—Specimen No. X2-H-2

Fig. 15—Specimen No. X2-H-3

Fig. 16—Fracture of specimen No. X2-H-2

Fig. 17—Specimen No. 3-H-1

Fig. 18—Specimen No. 3-H-2

Fig. 19—Specimen No. 3-H-3

Fig. 20—Fracture of No. 3-H-2

MICROGRAPHS AND FRACTURES OF VANADIUM PIG IRON

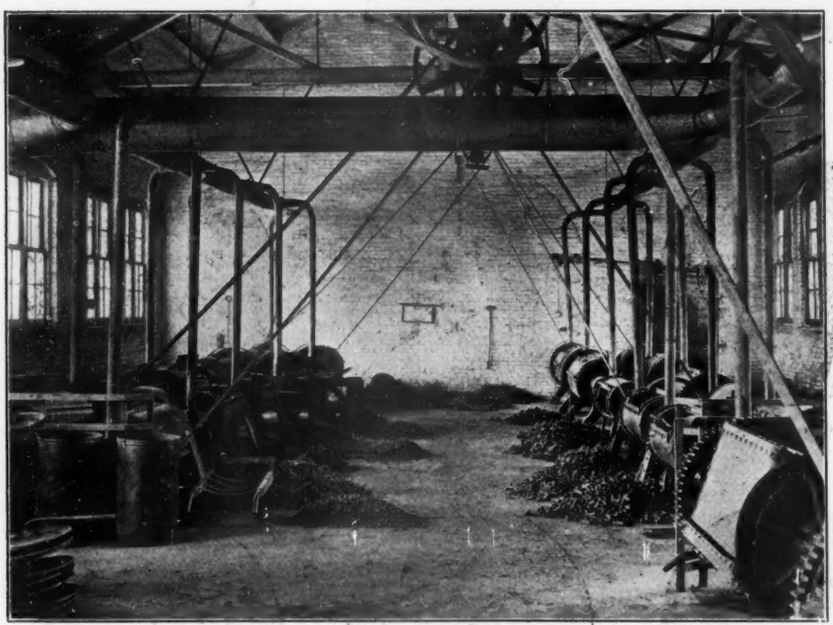
19, specimen 3-H-1 was etched to show the granular structure of the metal; the others are polished to show the graphite. These would also indicate that the metal was uniform in structure. The fracture of one of the tensile specimens, Fig. 20, shows a fine granular gray iron, which was a little harder than the others tested, but fairly easy to machine and had fair polishing qualities. This iron would be good for such castings as require a hard, close grain surface.

There are some general characteristics common to these five grades of Thomas iron. The castings are homogeneous, sound and remarkably free from blow holes and other defects; they give fine granular gray castings, which are all easy to machine and take a fair polish; the test specimens showed uniform strength of characteristic proportions for gray iron, with the exception of No. 2 plain, cast 600, from Alburtis furnace, which was a very strong and tough iron, but still of close grain and easy to machine.

The addition of scrap will without doubt add to the polishing qualities of all these grades. From my experience with No. 1X with 40 per cent machinery scrap, this iron takes a good polish, and gives castings which are easily machined.

The greatest loss in vanadium from the pig iron to the casting was in the No. 3 foundry, where the vanadium dropped from 0.044 per cent to 0.038 per cent. In test No. 600-A, there was no loss in the vanadium, which was 0.046 per cent in the pig iron and 0.046 per cent in the casting. The closeness of the grain and the softness of all the castings under the tool, are characteristic of iron which contains vanadium. In his article on "Vanadium in Pig Iron" (Transactions of American Institute of Mining Engineers, pages 883-886, February, 1912) Dr. P. W. Shimer says that "There is reason to believe that the effect of vanadium on the strength and other qualities of these irons is noticeably beneficial, and titanium probably acts in a similar way. When these elements are present in notable amounts, there is often a peculiar fine-grained structure combined with softness and unusual strength." In this article Dr. Shimer explains why irons containing vanadium are generally finer grained than those irons of similar silicon and sulphur content, which do not have vanadium.

It will be noted that most of the five irons tested were low in combined carbon, and ordinarily would have had coarse grains of graphite.



CLEANING ROOM OF ACME FOUNDRY CO., CLEVELAND

Too Much Coke on the Bed

By J. H. Taylor

I noted in the April issue of THE FOUNDRY, page 162, the article discussing "Cupola Melting Difficulties", and it is evident that this foundryman used entirely too much coke on the bed for a cupola of this size. The cupola I operate is lined to 32 inches and we charge only 550 pounds of coke on the bed. We melt from 9,000 to 10,000 pounds of iron in one hour. The cupola is equipped with four tuyeres, 8 inches in diameter at one end, increasing in size to 14 inches, and these are 4 inches deep. The use of a bent rod to measure the height of the coke bed is an old trick, but evidently due to an error, the article states that this should be done about 45 minutes before the iron is to be tapped. It should have been added that the iron charge should have been placed on the coke bed. It also is stated that 150 pounds of coke is used between charges, whereas 100 pounds will be sufficient.

Dust Collector for Large Cleaning Room

In an effort to promote efficiency and economy in its cleaning room, the Acme Foundry Co., 5217 Sweeney avenue, Cleveland, early this year decided to install a new dust collecting system. The new collector has been in operation for more than four months and has given complete satisfaction, the air which is passed out through the fan being so clear that there is little abrasive action on the blades of the fan. The collector was furnished by the Knickerbocker Co., Jackson, Mich.

The installation was a large one, as the collector handles dust from 34 tumbling barrels. These barrels were furnished by the W. W. Sly Mfg. Co., Cleveland, and are of the assorted sizes commonly used for cleaning light gray iron castings.

As shown in the accompanying illustration, each barrel is connected by a small pipe to a larger pipe, which opens into the main pipe leading to the collector. The pipes are carried from above by sheet iron hangers.

Power is furnished by two 30-horsepower motors, installed by the Lincoln Electric Co., Cleveland. The motors are of ample capacity to drive the tumbling barrels and fan, and in case of the failure of one motor, the other can furnish power for driving the fan and 22 barrels.

The fan, which was furnished by the American Blower Co., is installed in a gallery over the cleaning room. The dust-laden air exhausted from the tumbling barrels is led through the large pipe, shown at the left of the illustration, into the dust collector. The air is swirled around and the heavier particles drop of their own weight to the bottom of the collector. The pipe leading to the fan is located at the top of the collector and the air drawn through it is almost free from dust. The fan discharges the air through a tail pipe.

THE BRASS FOUNDRY

The Use and Care of Crucibles

IN HIS report on "Brass Furnace Practice in the United States", recently issued by the Bureau of Mines, Dr. H. W. Gillett discusses at length the proper treatment of crucibles.

Although crucibles are free from moisture when removed from the kiln, they rapidly absorb it, and many take up 5 per cent of moisture during shipment from maker to user. If, instead of eliminating the moisture by a gradual annealing, the damp crucible is put directly into a hot furnace, or into a cold one and heated too rapidly, the mosture will be changed into steam so rapidly that the steam evolved will blow pieces of the crucible off bodily; that is, the crucible will "scalp."

To prevent this the crucible must be raised from room temperature to a temperature somewhat above the boiling point of water very gradually, so that the moisture may be driven off gradually without "scalping" of the crucible.

Crucible Storage

There is always an abundance of waste heat that can be utilized for warming the place where the crucibles are stored. A common place for crucible storage in foundries using pit furnaces is just back of the battery of furnaces. The waste heat may also be led through a special oven, so provided with dampers that the heat may be gradually admitted for annealing a fresh batch of crucibles. After annealing has been finished the oven may be utilized as a warm storeroom. Crucibles are sometimes stored above a core oven, or, in a rolling mill, above an annealing furnace, a good practice if the oven or furnace is run constantly enough to keep the crucibles dry.

Most foundrymen are fairly careful about annealing their crucibles, but many do not pay enough attention to the tongs used and the way the crucibles are handled with them. The greatest damage to crucibles is done with improper tongs or with tongs improperly handled.

There are several different types of crucible tongs for pit furnaces, some of which are shown in the accompanying illustration. No. 1 is a one-prong type, mainly used in pit furnaces burning anthracite coal, as in rolling mills. The prong comes just below the bilge, because the difficulty of poking tongs through the anthracite and its ash is greater than through coke and its ash, so that tongs that come farther down the crucible are a little harder to use in coal furnaces. The handles are spread, the tongs squeezed into place, and a link slipped over them to seat them tightly. A mechanical hoist operated by hand, air, or electricity, is fastened into the hook at the pivot.

No. 2 in the spade type. In the illustration this type is shown with hooks on the handles for lifting the pot by hand without mechanical hoist. An iron bar is passed through the hooks and the pot lifted by two men, one on each side of the furnace.

No. 3 represents a two-prong tong, one prong being above and one below the bilge, with trunnions for pouring. On Nos. 1 and 2 the tongs are used merely for lifting the crucible from the fire and setting it into the pouring shank. With No. 3, the crucible is held by the tongs during pouring, being carried on a shank of such form that the shank may be held horizontal while the tongs are tilted on the trunnions; or, a bail may be attached to the trunnions and the tongs and crucibles held by a traveling crane.

In the first three forms the crucible is pinched tightly in the tongs and the tongs are held in place by a link slipped over the handles. To put on the link and get it tight is hot work, as it must be done directly over the open fire. Hence the furnace tender, instead of slipping the link down just tight enough to hold securely, is prone to jam it down, even driving it down with a poker or a skimmer.

The pinching of the crucible may in this way be very severe, as the hot crucible is soft and leathery and gives somewhat readily. It is common to see crucibles the mouths of which have been pinched into a distinctly oval shape. Every time the crucible is thus strained it is weakened and its life greatly shortened. To prevent this excessive pinching of types designated 1, 2, and 3, each of which may be termed the "pinch" type, the type designated 4 in the illustration, or the "grab" type, has been devised. This is intended for use with a mechanical hoist and may be made with one prong or with a spade prong if desired. In using the grab type the tongs are hooked into the hoist and lowered into place, the tongs being spread, and gently seated in place; the hoist is then slowly started upward, when the tongs take hold and the crucible is held by its own weight.

A toggle joint may be used instead of the chain illustrated, and in some cases hooks like those on No. 2 are put on, and the hoist carries an equilateral triangle, vertex down, which is hooked into both hooks and draws them down by the weight of the crucible.

For use in oil or gas furnaces the grab type with a toggle joint may be further improved by making the joint with a pair of stop lugs so that the tongs can open only far enough to clear easily the bilge of the crucible.

The handles of the grab type are often bent down at right angles just above the chain, hooks, or toggle joint, so that the tongs may be guided into place without getting the hands directly over the open furnace.

Grab Type of Tongs

Several foundries that use the grab type of tongs testified that with that type they could without question handle crucibles up to No. 250, holding about 650 pounds of metal. No instance of a crucible having been dropped by such tongs has been reported. Every firm using this type was enthusiastic in its favor, and said that no other form would be used, as the grab type greatly increased the crucible life. This type seems to deserve a much wider use than it now has.

No matter what type of tongs be used, if they get out of shape and do not fit the crucible at all points, excessive strain is put on the crucible at the points where they do touch. In the same way, the spade and two-prong tongs, having more bearing sur-

face than the one-prong, divide the strain more evenly.

Some foundries have only one size of tongs, and if now and then they have to use a larger or smaller crucible than the size ordinarily used, they will use tongs that do not fit. This practice is fatal to the life of the crucible.

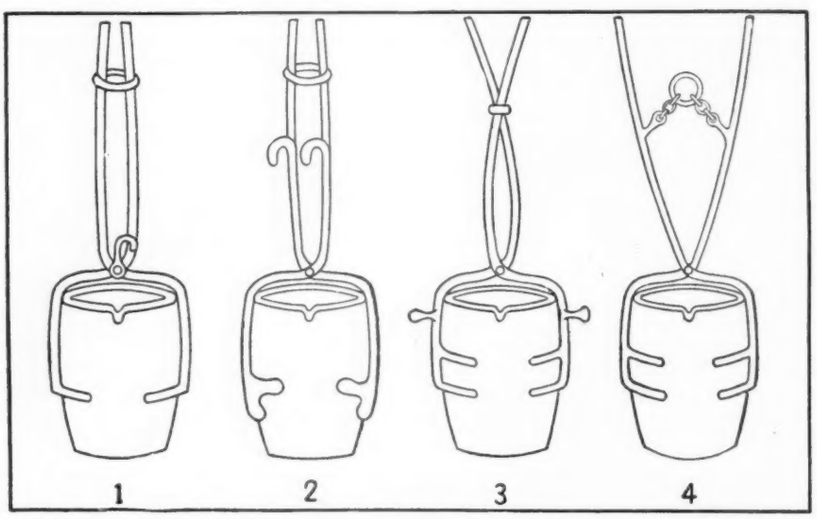
A crucible grows slightly smaller with use, owing to oxidation and wearing away of the surface. One foundry that reported an exceptional crucible life has three sets of tongs, differing slightly in size, which are selected according to the age of the pot.

An easy way to keep tongs in proper shape is to have a cast iron form just the size of the crucible used. As soon as it is seen that the tongs are slightly out of shape, they can be heated and pounded back into shape over the iron form.

Crucible hoists have been patented with which the crucible is raised on the block on which it sets, the block being in turn on a pillar which is raised up through the bottom of the furnace by air or hydraulic pressure, thus doing away with the lifting tongs entirely. There would be considerable difficulty in adapting this device to a coke or coal furnace, but it should be practical as applied to oil or gas pit furnaces. A shank can be designed that will take the crucible from the block without the use of tongs. Such a scheme, aside from putting the crucible to less severe usage, would allow the use of approximately cylindrical crucibles, such as are often used in tilting furnaces, a practice that would give more heating surface per unit volume of metal, and hence a faster melting speed and higher fuel efficiency.

A type of oil or gas furnace recently patented is made with the furnace shell hinged so that it can be opened and the crucible taken out by the use of a hinged or "scissor" pouring shank. However, the drawbacks to such a plan are many.

In rolling mills, the crucibles are usually lifted from the furnaces by a rope hoist operated by hand. The metal is poured while the crucible is still suspended by the hoist, without putting it in a pouring shank. The hand-operated rope hoist has been supplanted by electric hoists in a few mills, and controversy rages among mill men as to which is better, the hand or the electric hoist. The hand hoist requires hard muscular exertion on the part of the workmen, but can be operated more smoothly than the electric hoist, thus insuring steadier pouring and causing less spilling of metal. One progressive mill states, however, that it prefers the spilling of a little metal to the strenuous objection of the workmen to the hand hoist after once having used the electric hoist.



FOUR TYPES OF CRUCIBLE TONGS, 1. SINGLE PRONG TYPE; 2, SPADE TONG; 3 AND 4, DOUBLE-PRONG TONGS; 1. 2 AND 3 ARE OF THE "PINCH" TYPE AND 4 IS OF THE "GRAB" TYPE

An oxidizing atmosphere will burn the graphite from the outside of the pot and weaken it; hence for long crucible life in any furnace, especially in oil or gas furnaces, a reducing flame should be maintained. If an oxidizing flame is trained directly on the crucible the crucible becomes badly scored at that point. As the burners requiring low-pressure air and high-pressure oil are more easily controlled so as to give a reducing flame, and as they usually give a wider cone of flame, as ordinarily operated, they are easier on crucibles than the burners using high-pressure air.

If oil be allowed to spray strongly on a cold crucible before the burner is lighted, the oil will soak in, and "scalping" may result when the furnace becomes hot.

Sulphur dioxide from fuels high in sulphur is said to be highly deleterious to the crucible.

Allowing the crucible to remain in the fire longer than is necessary; that is, not taking the pot out when the metal is ready, or allowing the metal to "soak," increases the wear on the crucible; hence promptness in taking out the metal lengthens the life of the crucible and also prevents gas absorption and loss of zinc. The higher the temperature to which the metal is raised the harder the wear on the crucible. In foundries in which alloys of several melting points are used, crucibles are usually used for part of their full life in melting an alloy with the highest melting point, and are then used for alloys with lower melting points. Thus a crucible might be used for a couple of heats of pure copper, then for phosphor bronze, then for red brass, next for yellow brass, and finally, for aluminum. Used in this way, the total tonnage melted per crucible would probably be larger than if each crucible should be used for its full life on one alloy. Between changes in the alloy melted, it is necessary to clean the crucibles well from any adhering metal to avoid contamination from the previous charge.

Another way in which crucibles are injured is by wedging them full of cold ingots or scrap, which expand as they are heated to the melting point; the crucible does not expand so much, so that a great strain may be set up and the crucible be cracked, or at least, weakened.

Crucibles may also be badly injured mechanically by carelessness in poking the fire or in knocking off slag and clinkers.

Protective coatings are sometimes used in an attempt to prolong the life of the crucible. Havard mentions a paint of finely pulverized carborundum fire sand mixed with water glass or boric acid, and states that there is no doubt but that for certain purposes such coatings increase the crucible life. A protective coating of a nature somewhat similar to the foregoing is said to be largely used abroad and has recently been put on sale in this country. Reports from firms that are trying this are not based on long enough experience to be conclusive, but indicate that a saving may be effected in this way.

Bartley states that in a coal or coke furnace with proper fuel space for a given sized crucible the use of either a larger or a smaller crucible decreases the crucible life; Bartley also brings

out the important point that crucible life is shorter in square furnaces than in round ones, owing, no doubt, to the less even heating.

Wood cites three rolling mills, one of which used 67 pounds of coal per hundredweight and got 25 heats for the life of a crucible, another 50 pounds of coal per hundredweight and got 33 heats, and a third 33 pounds of coal per hundredweight and got 48 heats, all with the same make of crucible.

If the crucible is not allowed to cool down very far, but is kept hot continuously, so that there is less expansion and contraction, its life is lengthened. This is one reason for the longer life of crucibles in tilting than in pit furnaces. Continuous operation of brass furnaces for 24 hours a day is of course very rare. However, if the crucibles from a pit furnace, before they become cool, are promptly put back into the furnace after pouring, and if at night, after the last heat has been poured, the empty crucible is put back in the furnace and allowed to cool gradually with the furnace, the deterioration due to excessive expansion and contraction may be minimized.

Most of the replies concerning covers for pit coal or coke furnaces stated that either flat, fire-brick covers (the rolling mills using this form almost entirely) or dome-shaped, cast iron covers were used. Flat covers of cast steel or manganese steel were, however, highly recommended by a few users, and one firm uses a dome-shaped cover of malleable iron.

On most pit oil furnaces the covers are flat and of solid fire brick. On tilting-crucible oil furnaces they are similar, but for charging have a hole in the center, which may or may not be covered by a second smaller cover.

If a "feeder" or preheater is used, as on some pit furnaces of all types and on tilting oil and coke furnaces, it is usually fitted into a fire-brick ring, which serves as a cover to the furnace, the feeder itself not being covered.

No clear relation was found between the thickness of the lining and its life or the fuel consumption. On pit coal or coke furnaces the thickness of the lining varies from 3 inches, in rare cases, up to 9 inches, also in rare cases, the great majority being about 4½ inches thick. One user of this type uses a 15-inch wall between adjacent furnaces of a battery, so that a furnace may be cool enough to allow relining even when those on each side are running.

Furnace Linings

Pit oil furnaces and forced-draft tilting coke furnaces have, on the average, a 5-inch lining. The average thickness of the lining of tilting-crucible oil furnaces is about 6 inches, varying from 4 to 10. The linings of open-flame oil furnaces of the 500 to 1,500 pounds sizes are mainly 5 to 8 inches thick, with an average of 7 inches. The very large furnaces of this type have a 12-inch lining.

Most of the egg-shaped open-flame furnaces are lined with carborundum fire sand. This is also used in pit anthracite-coal furnaces and is used with kaolin and broken glass in one pit oil furnace. A somewhat similar composition which has been recommended is 70 parts carborundum fire sand, 15 parts ground fire clay, 8 parts water glass, and 7 parts water. Ground magnesite brick, or high-grade fire brick bonded by tar is also recommended, and for patching furnace linings the use of such a mixture of graphite and fire clay as is used in the manufacture of crucibles and is obtainable from crucible makers is suggested.

It is stated that the best fire brick for furnace linings is one high in alumina; that it should be of a basic character, so that slag will not be formed by the ash in contact with it; that it should have a smooth surface, so that clinkers will not adhere, and that it should have a high melting point. High-temperature asbestos cement is used in one open-flame oil furnace.

A few replies state that there is an increase in the life of the lining if special brick of the kind much used for blast-furnace linings be used instead of ordinary brick. At various plants tests of linings for pit furnaces, both of special clay and of corundite brick are now in progress and the results are reported as very promising.

The great majority of all furnaces, however, are lined with ordinary fire brick; if square, ordinary shapes are used; round, circle brick, large circular sections, or complete circles are used; other shapes are lined with special brick.

The life reported varies greatly, and is largely increased by frequent patching of worn places. The variation is extremely notable in open-flame oil furnaces, in which a lining may last from 250 heats to over 24,000, continuous operation (that is, fewer periods of expansion and contraction) and very frequent patching being conducive to long life. In general, in the same plant and under approximately equivalent conditions, for each of a given type of furnace the number of heats does not vary greatly with the size; hence the larger the furnace the less the repair cost per hundredweight of metal melted.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Cores for Brass Castings

We are making a number of heavy brass castings, but trouble is experienced as a result of the metal burning into the cores. We would like to have you advise us how these cores can be made to successfully withstand penetration by the metal.

The cores will have to be protected by a coating of plumbago, otherwise the metal will seep through the core structure and fill the space where the opening in the casting is required, with a mixed mass of metal and sand which is extremely difficult to remove when cold, as the sand blunts the tools rapidly. The application of plumbago might be termed *waterproofing* the core, as it has to be thoroughly done and it will be a good idea to keep this term in mind when doing this work. A perfunctory dipping of the core into a mixture of blacking and molasses water, which subsequently drains off almost entirely, is no protection whatever, nor is a thin coating of blacking or plumbago, applied as a paint, to be recommended. A good job of waterproofing requires a substantial coating of the protecting substance and this applies similarly to a mold which must be protected from penetration by a large mass of very fluid metal. A good grade of plumbago should be obtained and it should be mixed with molasses water to a paste. The paste should be rubbed on the cores with a piece of flannel or with the fingers, or

until the surface is smooth and lustrous and all sand interstices should be filled so that the metal cannot find an opening into the interior of the core. The core is dried after the application of the plumbago.

Yellow and Red Brass Mixtures

I would like to secure a mixture for yellow and red brass, as well as one for hard bronze.

The following alloys will be found satisfactory:

Yellow brass: Copper, 70 per cent; zinc, 25¾ per cent; lead, 3 per cent and tin, 1¼ per cent.

Red brass: Copper, 85 per cent; tin, 5 per cent; lead, 5 per cent and zinc, 5 per cent.

For all hard bronze castings other than bearings, bushings and parts of moving machinery use copper, 88 per cent; tin, 10 per cent and zinc, 2 per cent.

For hard bronze for bearings, bushings, etc., use 80 per cent copper, 10 per cent tin and 10 per cent lead.

Match-Plate Composition

We would like to have a good composition for plaster of Paris match-plates. If possible, the composition should not be brittle, as we have experienced some trouble from the chipping of plaster matches. Also kindly suggest a good flux for steam metal mixtures.

The following mixture is frequently used for match-plates: Portland cement, 2 parts; plaster of Paris, 1 part, and sharp sand, 1 part. For a flux use the following: Powdered glass, 8 parts; calcined borax, 1 part, and powdered charcoal, 4 parts; mix thoroughly and use sufficient flux to cover the surface of the molten metal, thus protecting it from oxidation. Powdered glass can be purchased in barrel lots and forms an excellent flux for brass and bronze.

Phosphor Bronze Mixture

Kindly furnish us with a cheap mixture for heavy-duty phosphor bronze bearings, such as are used on stone crushers, boiler plugs, etc. I would like to have two mixtures, one of which produces a reddish metal and the other, one of a yellow hue.

A cheap, heavy-duty phosphor bronze is unknown to the brass foundry industry. The following alloy generally is used for the service outlined by you: Copper, 79 pounds; tin, 10 pounds; lead, 10 pounds and 15 per cent phosphor-copper, 1 pound.

Yellow alloys are produced by the addition of zinc to copper, but zinc and phosphorus cannot be strongly recommended in connection in an alloy.

Difficulties in Making Cartridge Cases

In making cartridge cases, we have had very good results, yet at times some difficulties arise which we are unable to explain. We are making 3.5-inch cartridge cases, which are necked down to 3 inches. The metal is cast in iron molds with a capacity for 135 pounds of metal. We charge 140 pounds of metal to the pot, which is sufficient to pour one mold and the slab will make eight blanks. The mixture we use consists of 99 pounds of blanking scrap and cuttings from the ends of the cases, 26 pounds of copper and 15 pounds of zinc. The molds are heated and are coated with linseed oil and silver lead. The metal is poled with an iron pole, a piece of magnesium being attached to the end, which is used as a deoxidizer. We are not allowed to use a flux. The metal is melted in a natural-draft crucible furnace and the temperature of the metal in each pot is obtained with a pyrometer before pouring, the pouring temperature being 1,700 degrees. The metal is very ductile.

Occasionally the coating of lead will flake-off the mold, leaving small dirt holes in the slab and after the molds are clean, trouble is experienced until another heavy coating is placed on the molds. The metal contains shot marks on the heavy side of the mold, the drag side being heavier than the cope side. For the coating I tried another mixture consisting of fine oil and petrolatum, but no better results were experienced. After the slabs are delivered to the cartridge case shop, they are blanked-out and run through different presses. The losses on the first cupping are very small and from the first cupping to the necking no losses are experienced However, as soon as the cases are bottle-necked, the losses are from 10 to 15 per cent. The neck section crimps and the metal opens as if there were a seam between the two halves of the casting. I thought possibly that this was caused by dirt, but after a microscopic examination we could find no dirt, but the metal seemed to be folded together. Kindly let me know the cause of these various difficulties, directing attention to the mixture, the pouring temperature, etc.

As the coating of silver lead and linseed oil appears to give excellent results, there is no reason for changing. With the adoption of new methods, more or less difficulty would be encountered at first. In casting brass for rolling, lard oil is generally used as a coating on the molds, and the quality of the oil has an important bearing on the quality of the castings. Therefore, nothing but the best grades of strictly prime lard oil should be used. Mineral oils have no value as a coating for the molds. The object of using oil on the mold is to prevent oxidation of the metal as it is poured, which would result in dirt and dross in the castings. The oil burns as the metal is poured and furnishes a reducing atmosphere, which prevents the formation of oxide and tends to reduce any that may form before the stream of metal reaches the reducing zone. One of the best ways to clean the molds before the application of the oil is by the sand blast, as a slightly roughened surface is left which facilitates the adherence of the oil.

There is no particular advantage in poling the metal with an iron pole, but it should be thoroughly stirred. In using magnesium as a deoxidizer of brass or bronze, care must be used not to add too much or the quality of the metal will suffer. The amount should not exceed 0.05 per cent, or just enough to deoxidize the copper. We suggest that in melting the brass that a small amount of common salt, (NaCl), be added to the charge at the commencement of the melt. We are inclined to believe that the cracking of the brass while being drawn is caused by too great a draft being taken in the various operations, resulting in internal strains. The cracking in fact is due to fatigue.

The trouble could probably be definitely located by means of photomicrography. If overstraining is the cause of the difficulty evidence of the fact will be found in the increasing size of the crystal-grains through the various operations of drawing. Annealing at a low temperature before bottle-necking would probably be found a remedy.

We are unable to offer any suggestions regarding the composition of the brass as the analysis is not given.

Causes of Spongy Bronze Castings

We experienced considerable difficulty in casting bronze shafts used in large pedestal lamps. These shafts vary in size from 6 to 15 inches in diameter and are 3 to 8 feet long. Frequently the castings are cut through at the bottom, and sometimes in the next mold the castings are cut through the top. Occasionally also these castings are spongy.

In a majority of instances, spongy castings are due to faulty melting, and in this case the fact that they are only occasionally spongy would indicate that the mixture used contains the requisite amount of zinc to insure soundness un-

der normal conditions. It is impossible to be too careful in melting alloys of copper to avoid oxidation. We suggest observance of the following rules:

First—Proportion the charge so that the crucibles are never filled more than 1 inch from the top when new. This will allow space for charcoal on top of the molten metal, and prevent loss from overflowing when the white metal additions are made. When the crucibles become worn, reduce the charge of metal correspondingly.

Second—Do not hold the metal in the furnace after it has become sufficiently hot to pour.

Third—Use crucible rings in order to get all the charge in the pot when cold, and at the same time add sufficient granulated charcoal to cover the surface as the metal melts.

With reference to the cutting of the castings, this is a detail of molding which can only be remedied by properly fitting the core. It is important in this connection that the cores are straight; therefore, see that the core plates are not warped. The cores also must be so rodded that they cannot spring or bend, and in the case of the longer pedestals it may be necessary to anchor the cores in both cope and drag. It also must be understood that a green sand print will never safely hold a heavy core. The core prints should be reinforced by some rigid substance, so that the cores will not crush because of their weight or be lifted up by the pressure of the metal as it flows into the mold. Exact work is required in fitting cores into molds for thin and large castings. The only sure way of doing it is by the cut and try method, unless special rigging has been devised in the form of metal prints on cores, metal bearings in the mold core prints, and strong, rigid core irons connecting the metal prints of the cores. When metal fits on metal, there is no give and take, and if the core has been made true to shape without any swells, or other difficulties, and if the metal is poured at the correct temperature and at the proper speed, there is no reason why the castings should not be uniformly good. All of this presupposes that a large number of castings are required, otherwise it would not pay to incur the expense of fitting up for the work. In a jobbing shop, the only thing that can be done is to try the cores individually in each mold, ascertaining the thickness between the core and the sand surface of the mold through the medium of little pyramids of dough which indicate the metal thickness by the way they are flattened. The cores can be shaved off, if necessary to allow for the metal thickness.

Aluminum Rolls

We are making small aluminum rolls, approximately 24 inches long and 4 inches outside diameter, which have a thickness of about ½ inch. The mixture we are using consists of four parts of aluminum and two parts of zinc. The rolls, however, do not come solid and we cannot mold them on end as the patterns are made in such a way that they have to be molded on the side. We have tried a number of different methods of gating, but notwithstanding the various experiments tried, the castings are full of blow-holes which do not appear on top, but about half way between the top and the side.

If there is any reason to believe that the aluminum bushings could be made to better advantage if cast vertically in place of horizontally, no difficulty should be experienced in changing the method of casting, even though the patterns are made to be molded on the side. It is necessary only to cut a hole in one end of the flask for the sprue. The mold is made in a manner similar to that pursued when it is to be cast horizontally, except that the sprue is cut through to the end hole instead of being carried through the cope. The mold then is clamped and set on end with the sprue end uppermost. The aluminum is poured through the hole in the end of the flask. In all probability, however, it will be found that regardless of whether the bushings are cast vertically or horizontally, trouble will be experienced, as the alloy is too high in zinc to be cast well in sand. After taking into consideration the casting losses, it will be more economical to use a better alloy and the following is recommended: Aluminum, 82 per cent; zinc, 15 per cent and copper, 3 per cent.

Acid-Resisting Metal

Kindly furnish us with the analysis of acid-resisting metal which can be used for valves for pulp mills, etc.

The following alloy will be found satisfactory for your purpose: Copper, 85 per cent; tin, 10 per cent and lead, 5 per cent.

Transactions, American Institute of Metals

Volume VII of the 1913 *Transactions* of the American Institute of Metals contains a total of 381 pages and is the largest volume that has yet been issued by this society. The papers contained therein include "The Apprenticeship System in the Metal Industries", "How to Make a Time Study", "Internal Strains in Rolled Brass and Bronze Bars", "The Work in Metals at the Bureau of Standards", "The Nomenclature of Non-Ferrous Alloys", "The Brass Foundry of the Future", "A Report on the Co-operation Work of the Bureau of Mines with the American Institute of Metals", "The Efficiency Engineer in the Foundry", "How Scientific Management Worked in Our Plant", "Core Room Economies", "The Boiling of Metals", "The Application of Producer Gas to Brass Foundries", "Soldering Fluxes for Soft Solder", "Spotting-out and Silver-plating", "The Approximate Melting Points of Some Commercial Copper Alloys", "The Hering Electric Furnace for Commercial Brass Melting" and "The Non-Ferrous Alloy Test Specimen Question". In addition, numerous reports are included, as well as the discussions at the 1913 meeting of the society.

Hints for Welders

Two interesting booklets on oxy-acetylene welding and cutting recently have been issued by the Superior Oxygen Co., Pittsburgh. One contains condensed practical instructions for handling oxy-acetylene apparatus and it includes a large number of special diagrams showing correct methods of preparing material for welding. Some valuable hints on welding cast iron also are given. This booklet is accompanied by a circular describing various types of blow pipes, pressures, regulators, acetylene generators, etc., built by the Superior Oxygen Co. The blow pipes manufactured by this concern are provided with a special control valve which is equipped with an automatic cut-off. The character of the flame is adjusted by the acetylene valve and when the operator stops work he shuts off both gases with the control valve. When relighting the blow pipe he simply turns on the control valve and immediately has the proper mixture or gases at his disposal.

Death of Morris G. Loder

Morris G. Loder, sales manager of the Cleveland branch store of the Carborundum Co., Niagara Falls, died at his home in Cleveland, on July 9, aged 41 years. Mr. Loder was born at Strongsville, O., and for a number of years he was connected with the purchasing department of the Deering Harvester Co., Chicago. He entered the employ of the Carborundum Co. as sales manager of the Cleveland store in 1902. He is survived by his widow, mother, three brothers and a sister.

Mixtures for Chilled Cast Iron Car Wheels

A Discussion of Some of the Metallurgical Problems Involved with Special Reference to the Strength of Flanges

AT THE recent annual meeting of the American Society for Testing Materials, held at Atlantic City, E. B. Tilt presented an exceedingly interesting paper on Chilled Cast Iron Car Wheel Production. The problem confronting the car wheel manufacturer is the production of a sound wheel, which will be safe and will give good wearing qualities. All questions of design, including flange and plate thickness, which also include weight, have been disregarded, and the question is a purely metallurgical one—how to make white iron harder or more resistant to wear, and how to make the combination of white and gray iron in the flange stronger or tougher as well.

Fig. 1 shows a new 675-pound Master Car Builders' 1909 design wheel, in accordance with the specification with reference to chill. It may be stated that the Master Car Builders' specifications prescribe a method of selecting representative wheels for test, which are drop-tested for strength and thermal-tested to show their capacity to resist the heating action of the brakes. All wheels are inspected for molding defects.

Fig. 2 shows a flange which has been knocked off with a hammer to show the direction of break. This is one of the greatest sources of danger in the cast iron wheel, though a seam at the throat very often precedes failure. Fig. 8 shows a typical failure due to over-heating by the brakes. Figs. 3 and 4 show "brake burns" and "shell outs", respectively. These are minor defects, but to increase the service of the wheels they should

FIG. 1—A NEW 675-POUND, MASTER CAR BUILDER, 1909 DESIGN WHEEL

generally be a minimum. It is not known whether metal which shells out or brake-burns easily is dirty or has more impurities than a metal which does not.

There is at present some disagreement among authorities on chilled cast iron as to the best mixtures. Some contend that charcoal iron of chilling quality is necessary (No. 1); others that steel scrap and ferro-manganese (No. 2) serve the same purpose. A representative mixture of each is approximately as follows:

MIXTURE NO. 1.

	Per cent.
Charcoal pig iron	70
Scrap wheels	30

MIXTURE NO. 2.

	Per cent.
Coke pig iron	45
Old wheels	45
Malleable scrap	5
Steel	5

Wheels made by each mixture meet the specifications, and the advocates of each seem satisfied with the service results obtained. In the author's opinion, the latter depends on the final composition, and care of manufacture and inspection. Direct comparisons are difficult to make on account of different methods of keeping records, and comparisons of wheels made now of coke iron with wheels made years ago of charcoal iron are difficult on account of changes in the service conditions.

The improvement of the chilled iron lies then in the elimination or variation of certain of the constituents and their compounds, which compose the wheel; or in the addition of other elements or compounds. A representative analysis of the present-day wheel

FIG. 2—FLANGE KNOCKED OFF, SHOWING DIRECTION OF BREAK

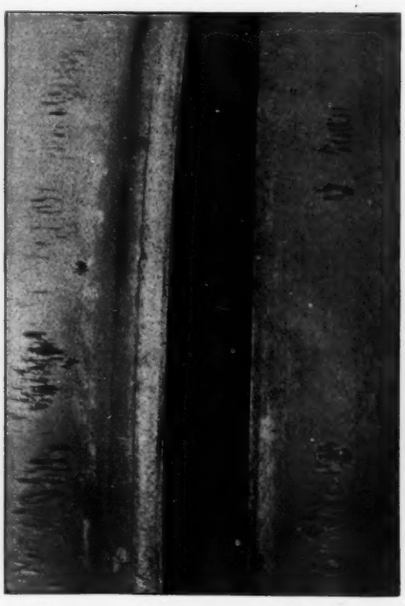


FIG. 3—"BRAKE BURNED" TREAD

FIG. 4—"SHELL OUTS" ON TREAD

iron, using coke pig iron and steel, follows:

	Per cent.
Total carbon	3.60
Silicon	0.60
Manganese	0.50
Phosphorus	0.30
Sulphur	0.12
Iron	remainder

It is supposed that the metalloids and their compounds, and the compounds of silicon and manganese, compose about 30 per cent of the total volume. Any one of the above can be varied by methods commonly known in foundries, and the best proportions are not definitely settled. Nickel, chromium, vanadium, titanium, and other metals have been used with results not always exactly determined.

It is the author's opinion, to be confirmed by further experiment, that the amount of total carbon should be low, say about 3.40 to 3.60 per cent, rather than about 4 per cent, as with many white irons. The silicon content will generally be somewhat higher than the manganese, both regulated by the practice of any particular foundry, but in the neighborhood of 0.60 per cent. Good wheels are made with sulphur as high as 0.17 per cent and phosphorus, 0.50 per cent. An examination of Fig. 1 will show the flange to be white iron in part, and Fig. 2 shows the broken flange continued down through the gray iron, which is the usual direction of breaking. Fig. 6 shows stress-deformation curves for gray irons from the sources noted, and for comparison the curve for the common steels is included. A curve for white iron is shown where it is thought it might be found, and from a consideration of this it is evident that the flange strength is dependent upon two substances. The first is the white iron which carries almost all the load until rupture takes place in it, when the gray iron back takes the load. We have thus successive failure of the white and the gray iron, and it is evident that if both could be of the same elastic ratio, an improvement would be made. A consideration of this suggests no possibility of attaining such a desideratum, so that a possible solution is to have as much white iron (a portion being necessary for wear) as can possibly be allowed, and thus also to have the gray iron as hard as possible without its being too brittle in the plates.

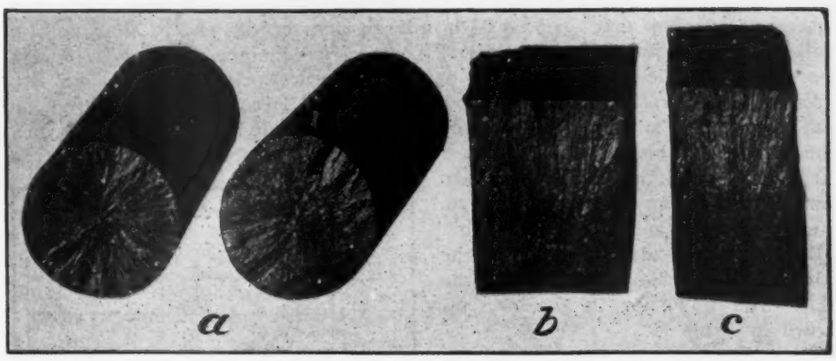


FIG. 5—(a) ENDS OF TWO CHILLED ROLLS; (b) END OF REGULAR WHEEL WITH FOUNDRY CHILL; (c) END OF PARTLY CHILLED RECTANGULAR BAR

In order to see whether the strength of white iron varied appreciably in our regular practice, it was decided to test chilled circular rolls, 2 inches in diameter (barber rolls), and partly chilled rectangular bars 1½ x 2½ inches. The combination chilled and gray iron bars are similar in structure to the flange of a wheel. These were drop-tested on 10-inch supports with a tup of 42.3 pounds, caught on the rebound. Fig. 5 shows the ends of two rolls, also a regular wheel, foundry chill block taken to show the amount of chill at each tap, and of one of the partially chilled test bars. Note the difference in the coarseness of the chill on the roll on the left, which was weak. On account of the elastic limit and tensile strength of chilled iron being practically the same, the drop is started at 8 inches and increased 1 inch at a time until the bar fails. The difference in height of the drop to break bars of widely different mixtures, in chills and in green sand, is given in Table I.

Table I

HEIGHT OF DROP TO BREAK BARS OF WIDELY DIFFERENT MIXTURES

Quality of Iron.	Silicon, per cent.	Combined Carbon, per cent (estimated).	How Cast.	Chill.	Height of Drop to Break, in.
Wheel iron	0.68	3.50	Chiller	Completely	15
Wheel iron	0.68	1.00	Green sand	None	27
Cylinder	1.27	....	Chiller	Around edge	14
Cylinder	1.27	0.90	Green sand	None	21
Machinery	1.60	....	Chiller	Mottled throughout	10
Machinery	1.60	0.60	Green sand	None	18

The wheel iron is the strongest, whether cast in chiller or in green sand. An interesting point is that when the wheel iron bars are annealed in the pits with the wheels (a period of four days), the average height of drop decreases from 15 to 12 inches. This would suggest that unannealed flanges are the strongest. When the unannealed bars are heated to 500 degrees Fahr. and tested at that temperature, the average height of drop is increased from 15 to 20 inches. This suggests less liability to strip flanges by blows under heavy brake service, when the wheels would be hot.

Records were kept for a number of months' operation of the wheel foundry, by plotting the results of drop

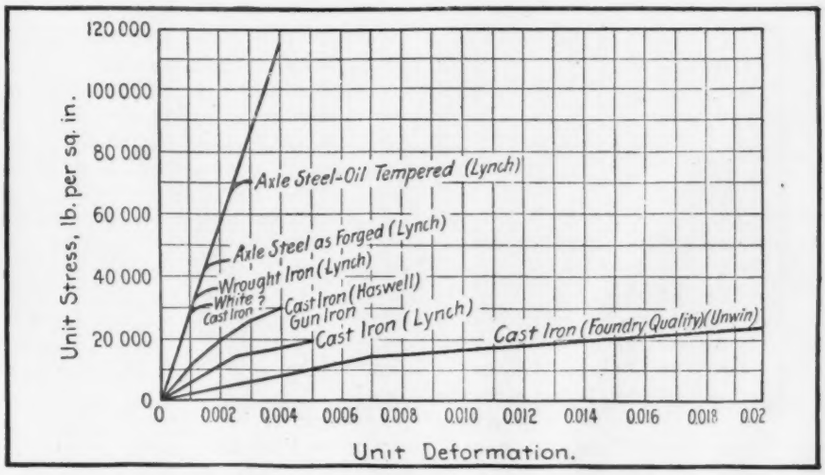


FIG. 6—STRESS-DEFORMATION CURVE FOR THE COMMON STEELS AND CAST IRON

tests of chilled rolls, of 1¼-inch square transverse test bars, of the chill on chill blocks, and of the hardness of the chilled rolls. A consideration of these results seems to show that the greatest strength of the white iron is accompanied by the greatest hardness, though the variation due to composition, or any other cause than flaws in the test specimens, is small.

Representative drop tests on the half-chilled 1½ x 2½-inch bars with the white iron down or in tension, are shown in Table II.

The difference in the amount of chilled iron has very small effect on the strength. This is in agreement with the foregoing, as the difference in amount is at or near the neutral axis and the strength of the metal at the surface varies very little.

In order to get a direct measure of the strength of the flange we have been drop-testing the flange of the wheels on a small drop-testing machine, with a 25-pound tup falling on a striking block 2 inches wide with a face having the contour of the throat of the flange. The wheel to be flange-tested is bored to a tight fit on a mandrel which forms a part of the foundation of the testing machine. After some experimenting 6 feet was taken as the height from which to drop the weight, and by taking one given weight and design of wheel, we have found that for the same mixture the number of blows to break off the flange is inversely as the chill. This means that a soft wheel has the strongest flange. In service we have more stripped flanges in soft wheels than in hard, but this is due to the development of cracks in the throat of the flange. This suggests that the design of the wheel and care in securing enough chill are more important than differences in quality or source of the iron.

Table II.

DROP TESTS ON HALF-CHILLED BARS

	Depth of Chill, in.	Height of Drop to Break, in.
Maximum	1.30 0.95	18 18
Minimum	1.05 0.60	12 12
Average	1.20 0.75	13.5 14

A possible improvement in wheel iron, to avoid trouble with broken wheels, is the making of an iron with a low coefficient of expansion under brake action. Heavy braking results in heating of the tread, with consequent expansion and pulling apart of the plates; it is the ability to withstand this service that is shown by the thermal test. Thermal tests on a large number of wheels show an increase in diameter of about 1/16 inch after the iron ring has been on two minutes, failure taking place after an increase of anything from 3/64 inch up, depending upon how much white iron or combined carbon is in the plates of the wheel. The harder the wheel, the more readily it is broken in the thermal test. Part cooling curves for wheel iron are shown in Fig. 7, and it would seem that shrinkage is fairly uniform for most irons of similar composition after solidification has taken place. Note the expansion in cooling of one wheel mixture which was soft. A wheel poured from this would have the flange and tread chilled and set at once and the expansion due to the gray iron behind might cause some checking of the chilled iron, which would show as a defect developed later in service. So, too, it has been thought by some that brake heating produces circumferential throat seams, due to expansion of the tread which is resisted by the flange. If low-expansion iron is a possibility, this tendency would be lessened.

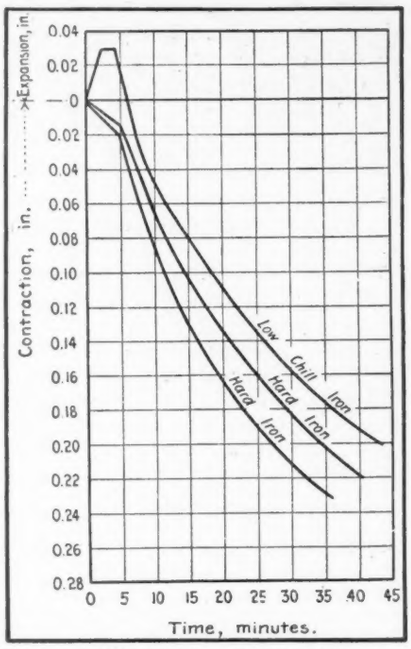


FIG. 7—SHRINKAGE CURVE FOR BAR 1 INCH SQUARE AND 12 INCHES LONG, WHEEL IRON, CAST IN SAND

Whether unclean metal or metal high in sulphur or manganese is the most likely to shell-out, the author cannot say, and it is hoped to get some connection between this trouble and the different coefficients of expansion of the compounds forming the metal.

Experiments have been in progress for some time and many test heats have been taken off. The fuels used have been high and low-sulphur cokes and anthracite coal, and the mixtures have varied from all-scrap wheels to mixtures with charcoal iron and malleable and steel scrap. Six test wheels have been cast from each test heat, of which two each have been thermal, drop and flange-tested. Up to the present there has been no improvement on our standard mixtures containing scrap steel. There have been only a few analyses and the tests, to show improvement, have been confined to those ordinarily made on wheels and bars. Our test work is to continue and it is our expectation that we will find mixtures and perhaps methods to improve the cast iron wheel.

In the discussion of this paper, Thomas D. West stated that it has been his experience, as a result of many tests, that partly chilled bodies, such as the rectangular bars cast by Mr. Tilt, give erratic results, as they are affected by slight variations in the temper of the sand, hardness of ramming, temperature of the metal when poured, etc. Mr. West pointed out that some better method than a combination of round and rectangular should be employed for studying the characteristics of chillable iron and to permit of working intelligently to make cast iron stronger and to obtain cast iron wheels of better wearing qualities. To ascertain the difference in physical properties that exists between the white and gray portions of the same metal, Mr. West said that as the result of many experiments, the same form of test bar must be used and all conditions surrounding the forming of both sets of bars must be the same and they must be cast at the same time.

Mr. West also directed attention to the fact that if a test bar is of a size that makes it sensitive to assume a mottled form, it is liable to go further and become almost white, and with the same iron, temperature of metal and character of mold, there is as much likelihood of obtaining a strength of 70,000 as 5,000 pounds.

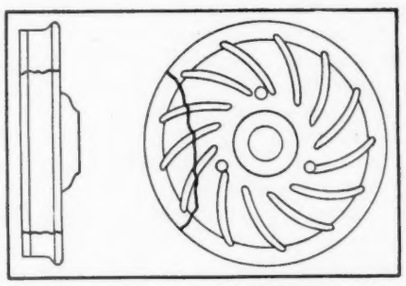


FIG. 8—TYPICAL FAILURE DUE TO OVERHEATING BY BRAKES

This sensitive condition, however, must be avoided when making com-

(*Continued on page* 316.)

Papers for A. F. A. Meeting and the Exhibitors

Tentative Program of the A. F. A. Convention to be Held in Chicago and a Partial List of Companies That Will Exhibit

EVERY indication points to a record-breaking attendance at the annual meetings of the various foundrymen's associations, which will be held in Chicago during the week of Sept. 7 to 11. Both the American Foundrymen's Association and the American Institute of Metals have prepared technical programs of unusual length and which will contain many features of great interest to all practical foundrymen. Practically 40 papers and reports will be presented and discussed by the members of the American Foundrymen's Association at their various sessions. A partial list of papers and reports follows:

Papers on Safety Work

"Safety in Foundry Operations," address by M. W. Alexander, General Electric Co., West Lynn, Mass.

"Safety First," by W. F. Riedenbach, Genesee Metal Co., Rochester, N. Y.

"Progress in the Safety First Movement," by Arthur T. Morey, Commonwealth Steel Co., St. Louis.

"Safety in Connection with Grinding Wheel Operations," by R. G. Williams, Norton Co., Worcester, Mass.

"Safety and Sanitation," by A. W. Gregg, Bucyrus Co., Milwaukee.

"Safety First—Driving Back the Saloon," by Thomas D. West, Cleveland.

Foundry Equipment and Appliances

"Electric Motors and Controllers for Foundry Operations," by S. H. Libby, New York.

"The Second Story Foundry," by G. K. Hooper, Hooper-Falkenau Engineering Co., Detroit.

"Economics of Motor Drive," by H. F. Stratton, Electric Controller & Mfg. Co., Cleveland.

"Abrasives in the Foundry," by Mr. Dietz, Norton Co., Worcester, Mass.

"Refractory Material," by Mr. Kelly, Harbison-Walker Refractories Co., Pittsburgh.

"Molding Sand Tests," by Dr. Richard Moldenke, Watchung, N. J.

Cost Congress

"Foundry Cost Keeping" address by F. J. Stevenson, Cost Expert National Association of Stove Manufacturers, Hoosick Falls, N. Y.

"Efficiency in Foundry Operations, the Essential Factor in Reducing Production Costs," address by A. K. Hathaway, Tabor Mfg. Co., Philadelphia.

"Efficiency in Foundry Work," by F. A. Parkhurst, Aluminum Castings Co., Detroit.

"Revision of the A. F. A. Standard Foundry Cost System," by Harrington Emerson, 30 Church street, New York City.

"Prevailing Practice in Estimating the Selling Price of Castings," by A. O. Backert.

Malleable Iron

"Manufacture of Malleable Cast Iron," by Harrold Hemenway, H. W. Cooper Saddlery Hardware Mfg. Co., Moline, Ill.

"Test of Malleable Cast Iron," by Enrique Touceda, Albany, N. Y.

"Effect of Silicon and Carbon in Malleable Iron Practice," by A. L. Pollard, Johnston Harvester Co., Batavia, N. Y.

"Malleable Iron Practice," by J. P. Pero, Missouri Malleable Iron Co., East St. Louis.

"Researches in the Annealing Process for Malleable Castings," by Oliver W. Storey, University of Wisconsin, Madison, Wis.

Steel Session

"The Electric Furnace in the Steel Foundry," by W. L. Morrison, Welland, Ont.

Discussion of Mr. Morrison's paper, by G. J. Stock, Darlington, Eng.

"Making Steel Direct from Ore in the Electric Furnace," by Prof T. A. Louden, Toronto, Ont.

"Side-Blow Converter Practice," by John Gregson, Sivyer Steel Casting Co., Milwaukee.

"Manufacture of Acid Steel for Castings", by A. F. Blackwood, Detroit.

"Notes on the Microstructure of Steel", by Prof. Wm. Campbell, New York City.

"Some Defects in Steel Castings and Remedies for Them", by John Howe Hall, New York.

"Report of the Committee on Steel Foundry Standards", by Dudley Shoemaker, chairman American Steel Foundries, Indiana Harbor, Ind.

Gray Iron Session

"Cast Iron With Unusual Structure", by K. W. Zimmerschied, General Motors Co., Detroit.

"Elimination of Waste in Bench Molding", by J. C. Pendleton and R. E. Kennedy, University of Illinois, Urbana, Ill.

"Report of the Conservation Congress", by Paul Kreuzpointer, Altoona, Pa.

"Report of the Committee on Industrial Education", by Paul Kreuzpointer, Altoona, Pa.

"Iron and Its Properties", by Peter F. Blackwood, Michigan Steel Castings Co., Detroit.

"Green Sand Cores", by James Mulvey, Rensselaer Valve Co., Troy, N. Y.

"Dangers of Specialization", by Thomas D. West, Cleveland.

"Semi-Steel", by R. H. Probert, James Leffel & Co., Springfield, O.

"Tests of Cast Iron", by W. P. Putnam, Detroit Testing Laboratory, Detroit.

"Memorandum on the Preparation of Standard Specifications for Cast Iron for International Export Use", by Dr. Richard Moldenke.

"Industrial Pioneering, or the Establishment of a Foundry in a New Territory", by L. L. Anthes, Anthes Foundry Co., Detroit.

The Exhibition

That the exhibition of foundry equipment and supplies to be held in the International Amphitheater will be equally as elaborate and on as large a scale as the exhibition last year is indicated by the large number of space reservations already made. The exhibition will be opened Saturday, Sept. 5, and will continue until Friday, Sept. 11. The list of manufacturers who have already reserved space, follows:

Ajax Metal Co., Philadelphia.
Arcade Mfg. Co., Freeport, Ill.
Armstrong-Blum Mfg. Co., Chicago.
Ayer & Lord Tie Co., Chicago.
Berkshire Mfg. Co., Cleveland.
Besley, Charles H., & Co., Chicago.
Blystone Mfg. Co., Cambridge Springs, Pa.
Brown Specialty Machinery Co., Chicago.
Buch's, A., Sons Co., Elizabethtown, Pa.
Buckeye Products Co., Cincinnati.
Carborundum Co., Niagara Falls, N. Y.
Cataract Refining Co., Buffalo.
Central Iron Works, Quincy, Ill.
Chicago Pneumatic Tool Co., Chicago.
Clark, Chas. J., Chicago.
Clark, Jas. Jr., Electric Co., Louisville, Ky.
Cleveland Pneumatic Tool Co., Cleveland.
Clipper Belt Lacer Co., Grand Rapids, Mich.
Coburn Trolley Track Mfg. Co., Holyoke, Mass.
Curtis Pneumatic Machine Co., St. Louis.
Dixon, Jos., Crucible Co., Jersey City, N. J.
Edgemont Machine Co., Dayton.
Essley, E. L., Machine Co., Chicago.
Electric Controller & Mfg. Co., Cleveland.
Federal Foundry Supply Co., Cleveland.
Felt & Tarrant Mfg. Co., Chicago.
Flexible Steel Lacing Co., Chicago.
FOUNDRY, THE, Cleveland.
Garden City Sand Co., Chicago.
Gardner Machine Co., Beloit, Wis.
General Electric Co., Schenectady, N. Y.
Gisholt Machine Co., Madison, Wis.
Goldschmidt Thermit Co., New York.
Gould & Eberhardt, Newark, N. J.
Great Western Mfg. Co., Leavenworth, Kas.
Great Western Melting & Refining Co., Chicago.
Hayward Co., New York City.
Henion & Hubbell, Chicago.
Hill-Brunner Foundry Supply Co., Cincinnati.
Hill & Griffith Co., Cincinnati.
Hunter Saw & Machine Co., Pittsburgh.
Independent Pneumatic Tool Co., Chicago.
Industrial Press, New York.
International Molding Machine Co., Chicago.
IRON TRADE REVIEW, THE, Cleveland.
Janesville Wisconsin Molding Sand Co., Janesville, Wis.
Kawin, Chas. C., Co., Chicago.
King, Julius, Optical Co., New York City.
Lupton's, David, Sons Co., Philadelphia.
McCormick, J. S., Co., Pittsburgh
McLain's System, Milwaukee.
MacLeod Co., Cincinnati.
Midland Machine Co., Detroit.
Monarch Engineering & Mfg. Co., Baltimore.
Norma Co. of America, New York.
Norton Co., Worcester, Mass.
Obermayer, S. O., Co., Chicago.
Osborn Mfg. Co., Cleveland.
Oxweld Acetylene Co., Chicago.
Pangborn Corporation, Hagerstown, Md.
Paxson, J. W., Co., Philadelphia.
Peerless Parting Co., Ottawa, Ill.
Pickands, Brown & Co., Chicago.
Pridmore, Henry E., Chicago.
S. K. F. Ball Bearing Co., New York.
Sand Mixing Machine Co., New York.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Sly, W. W., Mfg. Co., Cleveland.
Smith, R. P., & Sons Co., Chicago.
Sterling Wheelbarrow Co., West Allis, Wis.
Stevens, Frederic B., Detroit.
Sullivan Machinery Co., Chicago.
Superior Oxygen Co., Pittsburgh.
U. S. Graphite Co., Saginaw, Mich.

Vulcan Engineering Sales Co., Chicago.
Wallace, J. D., Chicago.
Warner & Swasey Co., Cleveland.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.
Wilmarth & Morman Co., Grand Rapids, Mich.
Wood's, T. B., Sons Co., Chambersburg, Pa.
Wyoming Shovel Works, Wyoming, Pa.

Mixtures for Chilled Cast Iron Car Wheels

(*Continued from page* 314)

parisons between an all-chilled bar and an all-sand cast bar of the same size, form and metal. To accomplish this, Mr. West added that it is essential to have the sand cast bars sufficiently large to prevent the mottled formation, and still not of a size to have them chilled throughout, when cast in an all-iron mold or chiller. Many experiments will have to be made to ascertain the best size of test bar to adopt for making comparisons between the white and gray portions of special, chillable iron. In conclusion, Mr. West said that the best diameter of bar to adopt for car wheel mixture was given in his paper entitled "A Suggested System of Test Bars for Chillable Iron", which was presented before the Sixth Congress of the International Association for Testing Materials, held in New York City, September, 1912.

A Water-Cooling System

During the summer the problem of securing suitable drinking water is one that faces every foundry superintendent. That temperature is an important consideration is shown by the experiments of Dr. Thomas Darlington, secretary of the welfare committee of the American Iron and Steel Institute. He found that the range of temperature at which water is palatable is extremely limited. It is most enjoyable when at 50 to 55 degrees Fahr. At this temperature it has a stimulating action on the heart, and relieves fatigue and exhaustion by equalizing the temperature of the body. Water that is warm is insipid and uninviting. Water which is very cold, as is well known, is liable to cause illness. Absences from work and inefficiency, particularly in the summer, have been definitely traced in many cases to the lack of a proper supply of drinking water.

A new system for properly cooling and distributing drinking water has recently been placed on the market by the H. W. Johns-Manville Co., New York. The water is cooled to the proper temperature in a refrigerating machine and is then piped to bubbling fountains placed at advantageous locations throughout the plant. The refrigerating machine uses sulphur dioxide vapor and the working mechanism is entirely enclosed. It is said that the machine requires but little attention and that it will operate for years without refilling. A thermostat is arranged to start and stop the machine at certain temperature limits, thus automatically keeping the water at a uniform temperature all the time. This system eliminates the disadvantages connected with the use of ice.

Manufacture of Steel Castings

"The Manufacture of Steel Castings", with special reference to the use of the Tropenas converter, is the title of a 48-page booklet issued by the Tropenas Converter Co., 50 Church street, New York City. Steel is defined and its various methods of manufacture are outlined briefly. The production of steel castings by various processes also is discussed and the history of the pneumatic process is given. Considerable detailed information regarding steel foundry practice by the Tropenas converter process is included, giving mixtures, analyses of iron used, methods of operating the converter, etc. This booklet should prove of value to manufacturers of steel castings generally, as well as to those interested in the installation of equipment for this work. The booklet is well illustrated with views of installations, intricate castings produced by this process, etc.

Pipe Plant for Australia

Benson Bros., Ltd., 51-53 Druitt street, Sydney, New South Wales, Australia, contemplate the erection of a cast iron pipe plant for the manufacture of pipe from 6 to 36 inches in diameter. This company would like to receive from American manufacturers printed matter describing clay mills, coremaking machines, ramming devices, machines for cutting off ends of spigot and faucet pipes, as well as machines for turning the faces, edges and backs of flanges, cupolas, magnetic separators and other equipment for installation in a modern cast iron pipe plant.

The Boston branch of the National Metal Trades Association, 141 Milk street, Boston, is compiling a file of catalogs for the use of its members and would be pleased to receive booklets, catalogs and other printed matter from manufacturers of machinery and manufacturing equipment.

The New York office of the Warren Foundry & Machine Co. has been removed from 111 Broadway to No. 1506-11 Broadway.

A Lesson in Fire Prevention

The conflagration at Salem, Mass., on June 5, in which $15,000,000 worth of property was destroyed, is another striking example of the destruction which so often follows the breaking-out of a fire among buildings constructed and roofed with inflammable materials. In 1902 Paterson, N. J., had a similar disastrous fire experience. Subsequently, however, an ordinance was passed prohibiting the use of wooden shingles or inflammable roof coverings within the city limits. Since that time, in Paterson and its immediate suburbs, more than 2,000 roofs have been covered with asbestos shingles and roofing manufactured by the H. W. Johns-Manville Co., New York City. The efficiency of asbestos roofing as a fire stop is illustrated by the fact that in the Salem fire sparks and burning embers were literally showered upon the roof of the Naumkeag Steam Cotton Co.'s storehouse, yet this building was absolutely unharmed because it was protected by Johns-Manville asbestos roofing, while other buildings around it were burned to the ground.

A New Brazing Material

A new cast iron brazing material known by the trade name of "Unifonte" is being placed on the market by the Phillips-Laffitte Co., Pennsylvania building, Philadelphia. This material is in the form of a paste which, combined with a flux and spelter, can be used to advantage for brazing cast iron. The brazing of the material is effected by the use of an ordinary brazing torch or gas blow pipe. No special plant is required for carrying out this process and tests of cast iron brazed with this material, it is claimed, show that the joint is considerably stronger than the original metal.

"Powdered Coal as Fuel" is the subject of a bulletin issued by the Quigley Furnace & Foundry Co., New York City, written by W. S. Quigley, and containing a reproduction of a paper read by the author at the annual meeting of the American Foundrymen's Association held at Chicago in October, 1913.

Frederic B. Stevens, Detroit, has compiled a buyers' index containing the names and addresses of manufacturers of products not frequently required in foundry operations, but which are necessary when stock is reduced. This index fits the pigeon hole of any desk and lists 1,100 items.

International Specifications for Cast Iron

Proposed Standards for Cast Iron Pipe, Various Grades of Foundry Iron and the Cast Iron Test Bar

AT THE recent annual meeting of the American Society for Testing Materials, the American members of the committee on specifications for cast iron of the International Association for Testing Materials reported that excellent progress was being made toward the adoption of international standards for cast iron. At the meeting held in Brussels, Dec. 5, 1913, all of the existing national and other specifications for pig iron, cast iron pipe and the test bar for gray iron castings were considered in the preparation of a draft of the American proposals for the international export specifications. The underlying thought of the Brussels conference was that every nation can best prepare its own standard specifications for materials of construction for home consumption. However, the small consumer in South America, Africa or some other non-producing country, is not in this fortunate position. The committee was of the opinion that he should be given standard specifications agreed to by the producing nations to give him the material he requires and this on a basis of equality in matters competitive.

Pig Iron Standard

At the Brussels meeting three standard specifications were adopted for presentation to the council of the International Association. The first proposal is for pig iron, which leaves practically the American standard specifications unchanged, but covers also iron for malleable and steel casting purposes and includes practically all of the European irons entering into the world's markets. The question of sampling and standard methods of analysis was referred to a special sub-committee. The next specifications apply to a proposed international test bar for cast iron. The American standard arbitration bar was reduced in diameter from 1.25 to 1.20 inches so as to come into agreement with the metric system and the test is to be taken with supports 18 inches instead of 12 inches apart, to accord more nearly with European practice. The standard specifications for cast iron pipe and fittings accord very nearly with the American standard specifications and contain such changes only as were necessary to satisfy European conditions of production and yet insure absolutely reliable material.

The proposals for pipe are not fully acceptable to the English consumers, as they differ slightly from standard English practice, but they are satisfactory to the British pipe founders. The proposals for the standard international test bar are satisfactory to all concerned, the English members having reserved the right only of suggesting minor modifications. The proposals for pig iron have not been accepted by English members, who presented a counter proposal. Probably the most important action of the international council meeting was the adoption of a strong resolution definitely committing the association to the preparation of international specifications for export purposes. It is believed that at the St. Petersburg congress to be held in 1915, these international specifications will finally be adopted.

The committee of the American Society for Testing Materials on standard specifications for cast iron and finished castings, through its chairman, Dr. Richard Moldenke, reported that during the last year two of the standard specifications have been considered for revision, namely those for locomotive cylinders and for malleable castings. The specifications for locomotive cylinders, as revised, are published on the Data Sheets which form a part of this issue of THE FOUNDRY. With reference to cast iron, the committee reported that owing to the peculiar nature of this material and the characteristics of general foundry practice, but little progress in the art is possible, as castings are made today the same as they were over 300 years ago. However, unless new methods of treating molten iron from the cupola or furnace are devised, such as desulphurization in partial measure at least, the society's standard specifications will have to be lowered somewhat to cover poorer material. Also it was pointed out that the requirements of the practice in gray iron casting make it necessary to use cast scrap in increasing quantity. The constant remelting of this material has gradually raised the sulphur content so that today it is double what it was 20 years ago. In revising the specifications, therefore, the sulphur limit will either have to be raised or this item will have to be stricken off entirely and the effect cared for in another way.

Malleable Standard

The committee reported further that proposed revised standard specifications for malleable castings have been prepared, but they are still in the hands of a sub-committee and will not be reported until next year. It was pointed out that there has been a marked change in the line of castings made of this material in recent years, as the steel casting industry now claims a large part of the heavy work. Therefore, there is a tendency to operate on light casting work only, with the consequent inability to make safe, heavy castings from the same heats. This situation, therefore, requires all the more attention in the revision of the standard specification as applying particularly to railroad work.

The proposed international export specifications for pig iron, cast iron pipe and fittings and for the cast iron test bar are presented herewith:

Cast Iron Pipe Specifications

Section 1.—The pipe shall be made with socket and spigot joints, or with flanges, and shall accurately conform to the dimensions given in the tables. They shall be straight and true cylinders with their inner and outer surfaces concentric, and shall be of the specified dimensions in outside diameter.

Note.—All measurements shall be stated in English and Metric figures; pressures in pounds and atmospheres.

When the length for a pipe is stated it is understood to be at least the "laying length".

Whenever pipe of thicker section are required, the increase of thickness may be obtained by reducing the bore, so as to maintain the outside diameter constant.

These specifications also apply to turned and bored pipe.

Turned and bored pipe shall be machined accurately so as to make

water-tight joints. When the pipe are driven together the spigots shall come within 5/8 inch of the shoulder of the socket.

Flanged pipe shall be faced on wide strips, straight across, or with check joints, as ordered. Bolt holes may be drilled or cored.

Allowable Variation

Section 2.—The diameter of the spigot ends and sockets of the pipe shall not vary from the standard dimensions by more than the following amounts:

0.12 in. for pipe 16 in.	or less in diameter
0.16 in. for pipe 18 in.	—24 in. diameter
0.20 in. for pipe 30 in.	—42 in. diameter
0.24 in. for pipe 44 in.	—48 in. diameter
0.30 in. for pipe 54 in.	—61 in. diameter

Allowable Variation in Thickness

Section 3.—For pipe the standard thickness of which is less than 1 inch, the thickness of the metal in the body of the pipe shall not be 0.12 inch less than the standard thickness; for pipe thicker than 1 inch, this deviation shall not exceed 0.15 inch, except that for spaces not exceeding 8 inches in length in any direction an additional variation of 0.02 inch shall be permitted.

These variations refer to castings from standard patterns.

For fittings a variation of 25 per cent greater than allowed for straight pipe shall be permitted.

Cutting Spigots

Section 4.—All pipe cast socket down must be made with a sink-head on the spigot end, to be cut off in a lathe, leaving the pipe of the standard "laying length". It shall be permissible to supply 5 per cent of the total order of pipe in lengths not over 10 per cent shorter than the standard length.

Fittings

Section 5.—Fittings shall be made in accordance with dimensions given in the tables provided.

The internal diameters of the sockets and external diameters of the spigots shall not vary from the standard dimensions by more than the following amounts:

0.12 in. for pipe 16 in.	or less in diameter
0.16 in. for pipe 18 in.	—24 in. diameter
0.20 in. for pipe 30 in.	—42 in. diameter
0.24 in. for pipe 44 in.	—48 in. diameter
0.30 in. for pipe 54 in.	—60 in. diameter

These variations apply only to fittings made from standard patterns.

Marking

Section 6.—The inspector shall mark each pipe with its class and number, also his initials, showing its acceptance. The weight shall be conspicuously painted in white on each pipe and fitting after the coating has become hard.

Variation in Weight

Section 7.—No pipe shall be accepted the weight of which is more than 5 per cent less than the standard weight. No excess above the standard weight of more than 5 per cent shall be paid for.

When pipe are cast to order, the total weight to be paid for under the contract shall not exceed the total of the standard weights of the whole order by more than 2 per cent.

No fittings need be accepted which are under the standard weight by more than 10 per cent for pipes 12 inches or less in diameter, and 8 per cent for larger sizes, except that curves, Y-pieces and breeches pipe may be 12 per cent below the standard weight; and no excess above the standard weight of more than the above percentages for the several sizes will be paid for.

These variations apply only to castings made from standard patterns.

Quality of Iron

Section 8.—All pipes and fittings shall be made of cast iron of good quality and of such character that the metal in the castings shall be strong, tough and of even grain, and soft enough to satisfactorily admit of drilling and cutting.

These specifications refer to iron remelted in the cupola, and not to metal taken direct from the blast furnace, or mixed iron, for the use of which special sanction must first be obtained and suitable regulations agreed upon.

Section 9.—Of the metal used, specimen bars, 26 inches long by 2 inches wide and 1 inch thick, shall be made without charge as often as the engineer may direct, and in default of definite instructions, the founder shall make and test at least one bar from each heat or run of metal. The bars, when placed flat-wise upon supports 24 inches apart, and loaded in the center, shall support a load of 2,000 pounds and show a deflection of at least 0.30 inch before breaking. The founder shall have the right to make and break three bars from each heat or run of metal, and the test shall be based upon the average results of the three bars. Should the dimension of the bars differ from those given above, a proper allowance therefor shall be made in the results of the tests.

Casting of Pipe

Section 10.—The straight pipe shall be cast in dry sand molds in a vertical position. All pipe shall be cast with the socket end down unless otherwise approved.

The pipe shall not be stripped or taken from the mold while showing color of heat, but shall be left in the flasks for a sufficient length of time to prevent unequal contraction by subsequent exposure.

Quality of Castings

Section 11.—The pipes and fittings shall be smooth, free from scales, lumps, blisters and holes, and defects of every nature which unfit them for use.

No plugging or filling will be allowed.

No pipes or fittings shall be rejected for faults which do not affect their usefulness for the work for which they were intended.

Cleaning and Inspection

Section 12.—All pipes and fittings shall be thoroughly cleaned, and subjected to a careful hammer inspection. No casting shall be coated unless entirely clean and free from rust and approved in these respects by the engineer immediately before being dipped.

Coating

Section 13.—Every pipe and fitting shall be coated inside and out with coal tar pitch varnish. The varnish shall be made from coal tar. To this material sufficient oil shall be added to make a smooth coating, tough and tenacious when cold, and not brittle or with any tendency to scale off.

Each casting shall be heated to a temperature of 100 degrees Cent. immediately before it is dipped. The ovens in which the pipes are heated shall be so arranged that all portions of the pipe shall be heated to an even temperature. Each casting shall remain in the bath a sufficient time for proper coating.

The varnish shall be heated to a temperature of 300 degrees Fahr. and shall be maintained at this temperature during the time the casting is immersed.

Fresh varnish or oil shall be added when necessary to keep the mixture at the proper consistency. After being coated, the pipe shall be carefully drained of any surplus. Fittings shall be coated in the same manner as pipe unless impracticable because of dimensions.

Hydrostatic Test

Section 14.—The straight pipes shall be subjected to proof by hydrostatic pressure, and, if required by the engineer, shall also be subjected to a hammer test under this pressure.

The pressures to which the different sizes and classes of pipes shall be subjected are as follows:

	20-in. diam., and larger, lb. per sq. in.	Less than 20-in. diam., lb. per sq. in.
Class A pipe.....	150	300
Class B pipe.....	200	300
Class C pipe.....	250	300
Class D pipe.....	300	300

Fittings shall be hydrostatically tested when specifically required by special agreement, which shall state the amount of pressure that shall be applied.

Weighing

Section 15.—The pipes and fittings shall be weighed at the foundry for payment under the supervision of the engineer, who may at any time require the examination and certification of the accuracy of the weighing apparatus. Castings requiring machining shall be paid for at "casting weight". Tenders shall be submitted and final settlements made on the basis of weight.

Section 16.—The founder shall provide all tools, testing machines, materials and labor necessary for the required testing, inspection and weighing at the foundry of the pipe and fittings. Should the purchaser have no inspector at the works, the founder shall, if required by the engineer, furnish a sworn statement that all of the tests have been made as specified, this statement to contain the result of the tests upon the test bars.

Power of Inspector

Section 17.—The engineer shall be at liberty at all times to inspect the material at the foundry, and the mold-

ing, casting and coating of the pipes and fittings. The forms, sizes, uniformity and condition of all pipes and other castings herein referred to shall be subject to his inspection and approval, and he may reject any pipe or other casting which is not in conformity with the specifications or drawings.

The inspector shall be fully competent to properly perform his duties, and must not retard the work of the pipe foundry by any neglect on his part, and if considered unfair and unreasonable in his inspection, the founder shall have the right to demand his removal and a competent and reasonable inspector placed on the work.

No pipes or fittings shall be rejected for faults which do not affect their usefulness for the work for which they are intended.

Section 18.—The inspector at the foundry shall report daily to the foundry office all pipe and fittings rejected, with the causes for rejection. A copy of the inspector's certificate to the engineer shall be simultaneously furnished the founder.

Castings Sound and Perfect

Section 19.—All pipe and other castings must be delivered in all respects sound and conformable to these specifications. The inspection shall not relieve the founder of any of his obligations in this respect, and any defective pipe or other castings which may have passed the inspector at the works or elsewhere shall be at all times liable to rejection when discovered, until the final completion and adjustment of the contract; provided, however, that the founder shall not be held liable for pipe and fittings found to be cracked after they have been accepted at the agreed point of delivery.

The manufacturer shall not be held responsible for any expenses or damages incurred in handling or using the castings. Any pipe or standard fitting that proves defective shall—when requested—be replaced by the maker, the measure of damage not to exceed the value of the casting. The manufacturer shall have the right to call for the defective casting to be returned before any allowance is demanded.

Definition of "Engineer"

Section 20.—Wherever the word "engineer" is used herein, it shall be understood to refer to the engineer or inspector acting for the purchaser and to his properly authorized agents, limited by the particular duties entrusted to them.

Specifications

Section 21.—The details of these specifications apply only to castings made from standard patterns. Any different or "special castings" ordered shall be in all regards subject to special agreement between buyer and seller.

Disputes

Section 22.—In the case of any disagreement upon the interpretation of any point arising out of these specifications, the matter may be referred by mutual agreement to an independent third party for decision.

Cast Iron Test Bar Proposal

1.—In order to obtain a reasonable uniform test bar (arbitration bar) for judging the qualities of iron poured into castings with reference to existing systems of measurement, a round bar shall be selected for testing transversely on supports 18 inches apart (45 cm.). The diameter of this bar shall be 1.2 inches (30 mm.), the relation of length to diameter being 15 to 1 as nearly as may be.

2.—The bars shall be cast in dry sand molds, vertically and with top-pour. They shall be cast 20 inches (50 cm.) long, and be rounded at the bottom. The load in testing shall not be applied faster than three seconds for every hundredth part of the diameter. For every specification mixture two molds with three test bars each shall be cast, the bars to be cold before removal from the molds which should have attained the shop temperature before pouring. The bars shall be brushed clean and not rumbled.

Pig Iron Specifications

1.—It is proposed that for international trading purposes in pig iron, the analysis be taken as the basis, inasmuch as the value depends upon its content.

2.—The following specifications for pig iron are recommended where the customary trade designations are insufficient (see tables below). For silicon a variation of 0.25 from analysis asked for, either way, shall be allowable. For sulphur and phosphorus the maxima given shall govern. For manganese a variation of 0.20 either way shall be allowable:

SILICON.[1]

Per Cent.	Code.
0.50	La
0.75	LaX
1.00	Le
1.25	LeX
1.50	Li
1.75	LiX
2.00	Lo
2.25	LoX
2.50	Lu
2.75	LuX
3.00	Ly
3.25	LyX
3.50	Lh
3.75	LhX

[1]Variation 0.25 either way allowable.

SULPHUR.

Maximum Per cent.	Code.
0.02	Sa
0.03	Se
0.04	Si
0.05	So
0.06	Su
0.07	Sy
0.08	Sh

PHOSPHORUS.

Maximum Per cent.	Code.
0.050	P
0.100	Pa
0.250	Pe
0.500	Pi
0.750	Po
1.000	Pu
1.500	Py
2.000	Ph

MANGANESE[1]

Per cent.	Code.
0.20	Ma
0.40	Me
0.60	Mi
0.80	Mo
1.00	Mu
1.25	My
1.50	Mh

[1]Variation of 0.20 either way allowable.

It was resolved that the code words above given are to be specially recommended as most useful for international commerce in pig iron.

3.—That the Council of the International Association for Testing Materials be requested to appoint a standing committee of chemists who shall draw up international standard methods of sampling and analysis of pig iron; and that the council ask the Verein deutscher Eisenhuttenleute, the Engineering Standards Committee and the American Society for Testing Materials to delegate suitable members to serve on this committee.

Cracking of Mine Car Wheels

By W. J. Keep

Question:—We are experiencing considerable trouble from chill cracks in chilled mine car wheels. Our cupola is lined to 36 inches, the blast being furnished by a blower operating at 2,200 revolutions per minute. We charge 1,400 pounds at a time consisting of mine car wheel scrap, 300 pounds; Nellie No. 2 foundry iron, 590 pounds; 300 pounds of foundry scrap and 210 pounds of open-hearth rolled steel scrap. The foundry iron analyzes as follows: Silicon, 1.90 per cent; sulphur, 0.025 per cent; phosphorus, 0.44 per cent, and manganese, 1.15 per cent. Our iron comes down fairly hot and the wheels we make are of the straight spoke type poured through the hub.

Answer:—If you have made good wheels from this mixture, then your silicon at the present time is a trifle lower than heretofore. You can reduce your car wheel scrap or any other low silicon scrap and increase your foundry pig iron until the cracking ceases.

To provide increased facilities for its growing business, the Duluth office of the H. W. Johns-Manville Co., has been removed to larger quarters at No. 327 West First street. These headquarters provide a large display room and the various products manufactured by this company including asbestos roofing, pipe coverings, packings, sanitary specialties, etc., will be carried in stock.

THE FOUNDRY

A monthly journal devoted to all branches of the foundry trade.

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Brass Foundry Losses

WHAT is undoubtedly the most comprehensive and complete report on melting and fuel losses in present brass melting practice is contained in a 298-page bulletin, recently issued by the United States Bureau of Mines. The investigation was made by Dr. H. W. Gillett, alloy chemist of the bureau, and reflects painstaking effort covering a considerable period of time. It is doubtful if a volume ever has been issued which so thoroughly discusses every phase of brass melting for casting purposes, and as a handbook for brass foundrymen it should prove of inestimable value. In the United States and Canada, there are approximately 3,600 plants melting brass and bronze, and 1,000 of these melt brass and bronze exclusively. On the subject of metal losses, the report contains the following:

> Allowing for the present recovery of waste metal, it appears that in current practice, between the purchase of the raw metal and the completion of the finished product, at least 5 per cent of the original metal is lost. Zinc passes into the atmosphere through the furnace stack; the other metals in the alloy may be oxidized and pass into the stack, may be spilled in the furnace ashes, or in one way or another may not be completely recovered.
>
> In the melting of non-ferrous alloys, taking into consideration all such alloys and all furnaces and fuels used, it is shown that from 90 to 95 per cent of the heat units in the fuel do no useful work. On the basis of $120,000,000 being the value of the metal passing through brass and bronze furnaces each year, a 2½ per cent melting loss, equivalent to 5 per cent loss on metal bought, means an annual loss of $3,000,000 in metal alone. Simply reducing the average metal loss to that of present best practice would mean a saving of over $1,500,000 a year. If fuel efficiency and crucible life could be brought from present average to best practice, half million dollars more, at least, could be saved.

One of the most striking facts to which attention is called by this investigation is the lack of proper control and of proper records in most of our furnace practice. Of the 1,650 plants to which Dr. Gillett sent the list of questions, only 230 sent any data and about 50 of these stated that no records were kept. Few of the plants that replied are under technical control, and it may be fairly assumed that the figures given in this bulletin represent the best practice in the United States. Dr. Gillett has concluded that it is doubtful if there are 50 firms in the country that have daily furnace records that are exact enough to allow the correction of avoidable losses. The firms that keep proper records, and hence have the necessary knowledge, invariably employ a trained metallurgist to supervise the melting furnaces, and these firms almost always have the lowest losses. That there is wide lack of technical control is emphasized by reports of metal losses varying from one-tenth of 1 per cent to 22 per cent and fuel efficiency from 1½ per cent to 16 per cent. The need for thorough technical control in the majority of our foundries and casting shops has been made evident by this investigation. Another waste, not so readily expressed by figures, but which none the less really exists, is the loss of efficiency of the workers in the industry through occupational disease and accidents due to a lack of safety precautions. A few of the firms reporting have given careful consideration to the prevention of disease and accidents, and it is shown that by the enforcement of simple, proper precautions occupational disease may be eliminated and the non-ferrous alloy industry placed beyond reproach as to

the health and safety of its employes. Investigation has also magnified the need of an efficient electric melting furnace in the alloy industry and a pyrometer which can be used as a workman's tool. These two problems are now under investigation by the bureau.

Another point that the work has particularly developed is the need of special studies of the absorption of gases, the speed of melting, the effect of oxidizing or reducing flames, increase of crucible life, decrease of time of heating after melting, the efficiency of furnace linings, the utilization of waste heat, the strength of draft, the combustion space of furnaces, and the saving of metal from waste material. During the progress of the investigation the important plants engaged in the non-ferrous alloy industry opened their doors freely to the employes of the Bureau of Mines and the written data furnished were supplemented by personal visits made by Dr. Gillett to 80 foundries and rolling mills in 13 states. The results of the investigation are of the greatest importance to the entire industry and undoubtedly will result in the correction of practices which today involve almost inconceiveable losses.

Crucible Steel Casting Industry

FREQUENTLY the statement is made that the crucible steel casting industry is on the decline in this country and the passing of the art is predicted in the not distant future. It is evident, however, that these prophets are not familiar with the statistics which show a steady gain in output in the last decade. In 1903 the production was only 5,409 tons, whereas last year's total aggregated 17,571 tons. The high record was established in 1912, when 20,550 tons of crucible steel castings were made. It is evident from these figures that there is a constantly widening use for cast crucible parts and while inroads may be made in certain lines by Bessemer, open-hearth and electric steels, the new avenues of consumption are more than sufficient to compensate for these losses. From 1898 to 1905 the output remained practically stationary, the tonnage in the former year having been 4,235 and in the latter 5,733. In 1906 the production of the previous year was practically doubled, namely 10,343 tons and in only one year since that time did the output fall below the 10,000 mark. In 1913, the total number of crucible steel casting plants, including foundries and steel works was 101, of which 82 were active and 19 idle.

Foundry Iron Production

THE importance of the foundry trade among the metal industries of the United States is reflected by statistics compiled by the American Iron and Steel Institute, which show that practically 20 per cent of the pig iron produced in 1913 was melted in cupolas and air furnaces. The total output of foundry iron, including ferro-silicon, which is placed at less than 100,000 tons, amounted to 5,084,952 tons last year, to which must be added 989,241 tons of malleable iron. The gross total exceeds 6,000,000 tons, and if to this is added the unknown quantity of scrap charged with every burden it is fair to assume that the output of castings exceeded 8,000,000 tons last year. Of the total output of pig iron in 1913, 21,442,267 tons were produced for the consumption of the makers and 9,523,885 tons were made for sale. The basic iron production reached a total of 1,909,279 tons, but unfortunately no figures are available showing the consumption for cast sections.

Trade Outlook

FOUNDRY trade conditions are practically unchanged and with few exceptions, shops are operating below normal capacity. Early in July many plants were closed for inventory and the melt was correspondingly reduced. From all section of the country, however, reports of improved sentiment are being received and with a record-breaking crop there is every indication of improved business for the fall and winter months. The railroads are beginning to place orders for cars and rails and they are slowly placing their shop requisitions which have been permitted to dam-up for nearly six months. One feature that foundrymen should not overlook is the threatened car shortage during the fall months. Western roads have been rushing all of their available equipment into granger states to move the crops and taking into consideration the cars on side tracks for repairs, it is doubtful whether there will be sufficient equipment to take care of the fall trade. It is particularly important, therefore, that orders for the winter supply of sand be placed early to insure delivery while weather conditions are satisfactory. Large consumers of pig iron have covered their requirements through the last half of the year, although smaller buyers, notwithstanding their depleted stocks, continue to cover only immediate needs. Pig iron quotations have shown no tendency to advance and in the leading centers foundry irons are quoted as follows: No. 2, Cleveland, $13.75; No. 2X, Buffalo, $12.75 to $13; No. 2X, Philadelphia, $14.75 to $15; No. 2, Chicago, $14, and No. 2, Birmingham, $10 to $10.25. Malleable iron is held at $14, Chicago, and $12.75 to $13, Buffalo. Valley furnaces quote basic at $13, but eastern Pennsylvania furnaces are asking $14.

Steel Casting Production

THAT the basic open-hearth steel casting process is maintaining its lead over the acid process is shown by the production figures for 1913, issued by the bureau of statistics of the American Iron and Steel Institute. The total production of open-hearth steel for casting purposes in 1913 surpassed all previous records and aggregated 910,216 tons; of this total, 460,161 tons were basic and 450,055 tons were acid. The next year of largest open-hearth steel casting output was 1912 with 870,848 tons and 1910 ranks third with 863,351 tons. The Bessemer steel casting process likewise showed a large growth, the production having increased from 68,750 tons in 1912 to 80,506 tons in 1913. The crucible steel process, however, showed a slight falling off, the total being 17,571 tons, as against 20,550 in 1912. Castings produced by the electric steel process showed a tremendous increase in tonnage from 4,162 in 1912 to 9,207 tons in 1913. This growth has been phenomenal since 1909, when only 306 tons were produced. In 1913 the production of all kinds of steel castings amounted to 1,020,744 tons against 966,621 tons in 1912, an increase of 54,123 tons, or nearly 5.6 per cent. Last year 223 foundries in 29 states, the District of Columbia and the Canal Zone, Panama, made steel castings, against 222 works in 1912.

SWING FRAME GRINDER WITH DUST EXHAUST CONNECTION

Swing Grinder With Dust Exhaust

A swing frame grinding machine provided with a protection hood and an arrangement for connecting it with a dust exhaust system, recently has been placed on the market by the Pittsburgh Emery Wheel Co., Pittsburgh, Pa. The machine is provided with roller and ball bearings throughout which make it easy to operate and tend to increase its life. It is designed to conform in detail with the requirements of the department of labor and industry of the state of Pennsylvania and is therefore particularly suitable for installation in communities where rigid dust exhaust laws are enforced.

The principal features of the machine are shown in the accompanying illustration. The frame consists of 4-inch horizontal and vertical pipes so connected through special castings and swivel joints that the grinding wheel may be moved in any direction. The relative positions of the motor and wheel are fixed and there is, therefore, no tendency to twist the belt or change its tension. In operation the dust is exhausted from the hood through the horizontal pipe which terminates in a flexible hose that may be attached to a permanent dust exhaust system. If the main dust exhaust pipes are overhead, connection may be made with the upper end of the vertical pipe which in turn may be attached to the horizontal pipe by means of a flexible hose. The weight of the head of the machine is balanced by a suitable counterweight.

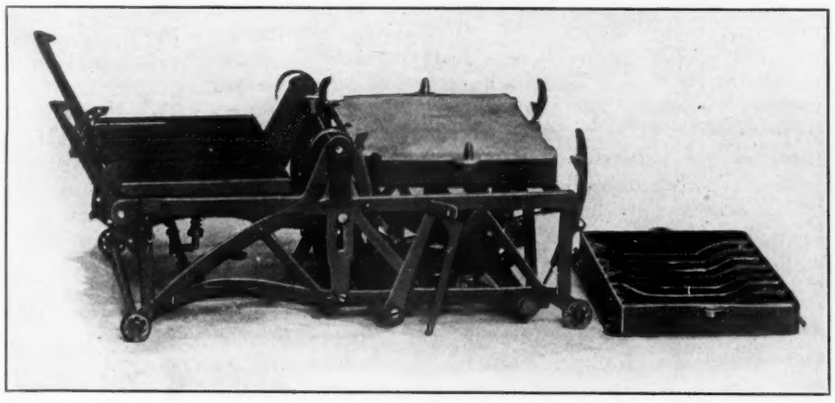
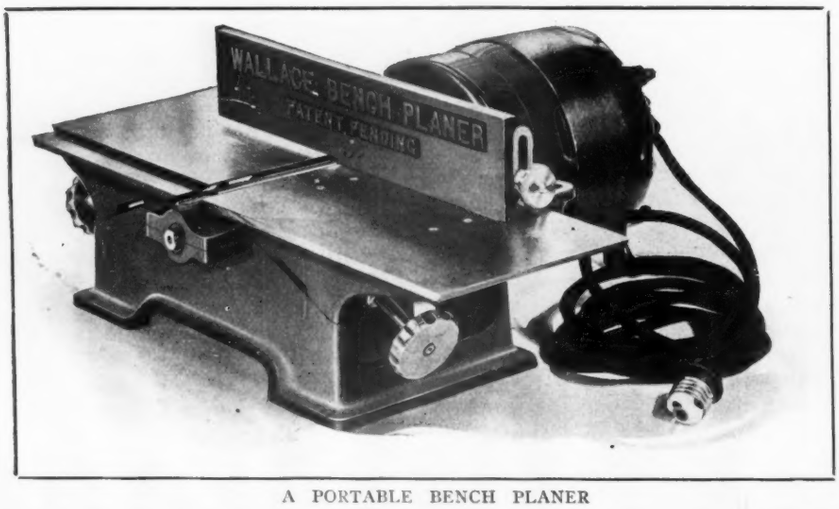


FIG. 1—STOVE PLATE MOLDING MACHINE IN POSITION TO RECEIVE COPE



A PORTABLE BENCH PLANER

Portable Bench Planer

A portable bench planer for pattern shops recently has been placed on the market by John D. Wallace, 527 W. Van Buren street, Chicago. It will plane lumber of any length and up to 4 inches in width. The table is 18 inches in length over all and the machine weighs 50 pounds. The table is adjustable for any depth of cut and the fence is adjustable to any angle. The machine is driven by a small electric motor and is designed to run from any ordinary electric light circuit. A plug is screwed into a lamp socket and the machine is started by turning a key. It is said that a man can handle this planer more easily than he can use a hand plane and since the machine can be placed on the bench, no time is lost walking around the shop or in waiting while other men are using the large planer.

Rock-Over Machine for Stove Plate

A new rock-over molding machine designed especially for making stove plate, using aluminum match plates recently has been built and patented by Wm. C. Lang, Cleveland. Mr. Lang is associated with the American Stove Co., Bedford, O.

The patterns may be easily mounted and dismounted, thus making it possible to handle several jobs on the machine in a day. The machine is semi-auto-

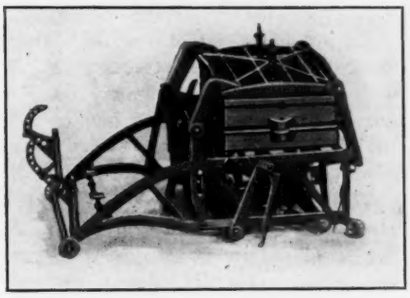
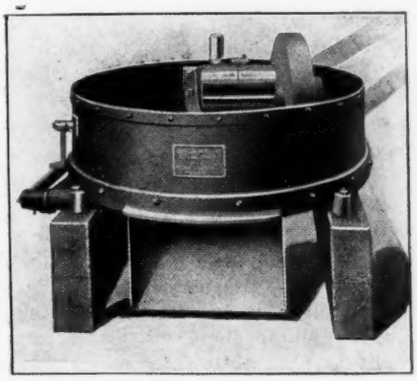


FIG. 2—DRAWING THE PATTERN AFTER THE MOLD IS COMPLETED

matic and makes a complete mold in one operation. The mold is rammed either by hand levers or air cylinders and the pattern is drawn mechanically.

In making a mold the drag is mounted on the table of the machine shown at the left in Fig. 1 and is filled loosely with sand. After the sand is in place, a bottom board is fitted to the flask and the drag is rolled over, exposing the cope side of the match plate as shown at the right in Fig 1. The cope and cope extension, which holds the surplus sand, is next fitted in place and loosely filled with sand, after which the follow board and clamp shown in Fig. 2 are set in place. The mold is then squeezed, after which the pattern is drawn from both the cope and the drag simultaneously. This is accomplished by holding the match plate in a fixed position and raising the cope and lowering the drag as indicated in Fig. 2. If the mold is deep, the machine may be so adjusted that all of the draft is in the drag. The compression head and the pattern plates are pivoted on two separate hinge bearings at the center of the drag.

In commencing the work in the morning, a complete mold is made and the cope is shaken out, the drag being



SIMPSON SAND MIXER

set on the floor. When the second mold is made, the cope is placed on the first drag on the floor and the second drag is set on the floor to receive the cope from the third mold. This process is continued throughout the day.

Simpson Sand Mixer

A recent addition to foundry equipment is an intensive foundry mixer, designed by P. L. Simpson, of Chicago, and manufactured by the National Engineering Co., Otis building, that city.

As shown in the accompanying illustration, it consists of a circular pan, 4 feet in diameter and 18 inches deep. The pan is stationary and the central shaft revolves, carrying a series of plows and a roller. The plows turn the material alternately toward the center and toward the rim, while the roller revolves over the mass of material, following the plows. This insures a thorough incorporation of the mixture. New sand in its natural,

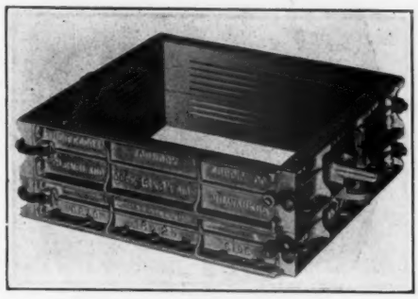


FIG. 1—ADJUSTABLE AND INTERCHANGEABLE ALUMINUM SNAP FLASK ASSEMBLED

lumpy state, either dry or wet, may be thrown into the machine with old sand without being previously riddled and is so thoroughly mixed that no new sand particles can be seen after a few minutes of mixing. This results in great saving of new sand, because a very small percentage of new sand will reclaim a large percentage of old sand.

The underlying idea is the action of the roller, which squeezes and kneads the grains of sand with each other. This, however, does not affect the size of the sand particles, as the machine is constructed to avoid any grinding action and the original porosity of the sand mass is maintained while its plasticity and toughness are increased.

One charge consists of 3½ to 4 cubic feet and the actual time for mixing in the case of core oil sand is about 2 minutes and for facing sand, from 3 to 4 minutes.

When mixing is completed, a door in the bottom of the pan is opened and the mixture falls through the chute, the plows automatically emptying the pan in a few revolutions.

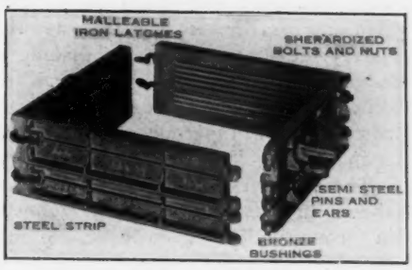


FIG. 2—SNAP FLASK UNHINGED

Adjustable Aluminum Snap Flask

The Federal Foundry Supply Co., Cleveland, recently designed a new type of aluminum snap flask, which is adjustable and interchangeable. Also it has increased its line of foundry equipment by the addition of a vibrator and rotary knee valve.

The flask, which is shown assembled in Fig. 1 and unhinged in Fig. 2, is made of aluminum with the exception of the pins and ears, which are semi-steel while the catches are malleable iron and the bolts are made of cold-rolled stock. With the exception of the aluminum, all of the parts are sherardized, thereby protecting them from rust, pitting or corroding. The hinges contain bronze bushings and the top of the flask is protected with steel strips. The sides of the flask are grooved on the inside to hold the sand, the same as a wooden flask. They average about 15 per cent lighter in weight than wooden flasks. Notwithstanding that the flasks are built in sections, they contain no loose pieces and the end and joints all are machined and drilled with templets, thereby insuring a perfect fit when assembled. As these flasks are adjustable and interchange-

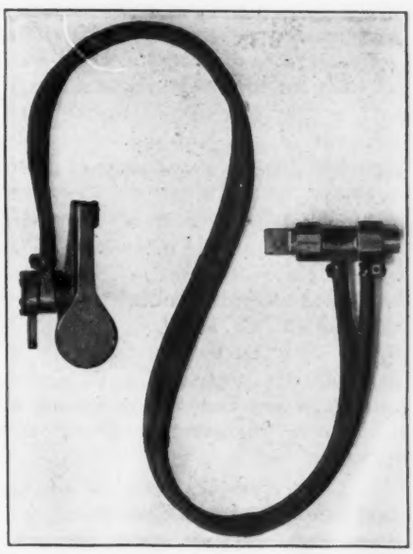


FIG. 3—COMBINED VIBRATOR AND ROTARY KNEE VALVE

able, the flask equipment to be carried necessarily is reduced, as the extra side pieces permit of making a large number of sizes. Five ends of different size and nine sides of assorted size will permit of making 45 snap flasks.

The vibrator and rotary knee valve shown in Fig. 3 is exceedingly novel in construction and contains no springs.

The vibrators are made from phosphor bronze and contain steel plugs and steel pistons. Each vibrator has two inlets, the first taking the air and blowing the piston off center in case it should be there and likewise blows out any water that may be in the line, together with any dirt that should happen to fall into the exhaust opening. The second inlet sets the vibrator in motion. These operations are performed with one movement of the hand or knee on the knee pad, which actuates the valve. The knee valve is of the rotary type with two outlets and is made of phosphor bronze.

Personal

Paul Ryan, sales promotion and advertising manager of the National-Acme Mfg. Co., Cleveland, has resigned to accept the position of general manager of sales of the Osborn Mfg. Co., Cleveland.

George A. Burman, formerly special representative of the Crawford Oil & Chemical Co., Cleveland, is now financially and actively interested in the Werner G. Smith Co., Cleveland, manufacturer of a new vegetable oil for making cores known as "Linoil."

Dudley A. Johnson succeeds the late Sam Mayer as Chicago branch manager of the Joseph Dixon Crucible Co., Jersey City, N. J. Mr. Johnson has for a number of years been an assistant to Mr. Mayer at Chicago, and he therefore comes to the management of the Chicago office fully equipped by the experience of many years.

At a recent meeting of the board of directors of the Cleveland Wire Spring Co., Cleveland, W. A. Comstock was elected president to succeed the late R. C. Moodey. Other officers were elected as follows: E. S. Page, vice president; J. W. Campbell, secretary and treasurer, and E. L. Farrow, assistant secretary and treasurer.

F. C. Brooksbank, president of the Tilghman-Brooksbank Sandblast Co., Philadelphia, manufacturer of sand blast machines, severed his connection with that company on June 30. B. C. Tilghman has been elected president to succeed Mr. Brooksbank and Chas. B. Showell is vice president and general manager. The company contemplates placing two machines on the market in the near future.

Arthur F. Braid has resigned his position as metallurgical engineer with Goldschmidt Thermit Co. and has purchased an interest in the Walker Starter Co., Lacon, Ill. Mr. Braid will be actively associated with the Walker company as sales manager in the Cleveland district; he is also a member of the board of directors. This company has a temporary plant which it is operating at full capacity and the management is looking for a suitable site for the permanent plant

DUDLEY A. JOHNSON

which will include a foundry, machine shop, etc.

"The Red Iron Ores of Eastern Tennessee" is the subject of a 173-page bulletin issued by the Tennessee state geological survey and compiled by Ernest F. Burchard, geologist of the United States geological survey. This bulletin describes the red iron ores of what has been termed the Chattanooga district and directs attention to the importance of the southern iron ore fields. A number of valuable maps are included and several southern blast furnace plants are illustrated.

An exceedingly handsome booklet, containing photographs in colors of the Panama Canal, has been issued by the Ingersoll-Rand Co., New York City. The descriptive matter is a reprint of an article published in *Scribner's* magazine, July, 1913, written by Emory R. Johnson, special commissioner on traffic and tolls. The views show this stupendous work in great detail and their reproduction in color greatly add to their attractiveness.

Trade Notes

Six hundred employes of Abenroth Brothers, Port Chester, N. Y., were guests of the company on Friday, July 3, at an outing held at Little Captain's Island on Long Island Sound.

The Terry Steam Turbine Co., Hartford, Conn., has received an order from Odero & Co., Sestria, Ponente, Italy, for 24 steam turbines. Last year this company placed an order for nine turbines with the Terry company.

The board of education of Elyria, O., has decided to install a foundry in the technical school of that city and the contract for the complete outfit of foundry equipment, including cupolas, blowers, brass furnaces, etc., was awarded to Frederic B. Stevens, Detroit.

The Industrial Refining Co., 11 Grace street, Irvington, N. J., recently has been organized to engage in the manufacture of liquid core compound for foundry use. It is claimed that this compound can be used with molding and gangway sand and is adapted to large, medium and small cores.

The Buffalo office of the E. J. Woodison Co., Detroit, Mich., has been removed from 378 Ellicott Square building to the Thomas power building, 1200 Niagara street. A warehouse is available and a large stock of foundry supplies will be carried to meet the requirements of the Buffalo trade.

The Independent Pneumatic Tool Co., Chicago, has established a sales room and warehouse at 334 St. James street, Montreal, where the Canadian business of this company will be transacted after Aug. 9. A complete line of pneumatic tools, electric drills, accessories and spare parts, will be carried in stock. W. H. Rosevear, who has been prominently identified with the railway supply and tool business in Canada for many years, will be general manager of the Montreal branch.

The Linde Air Products Co. of New York, has recently established distributing stations at 118 Harrison street, Davenport, Ia.; 514 Molino street, Los Angeles, Cal., and 324 North First street, Minneapolis, Minn. In addition to these distributing stations, a new plant for the manufacture of oxygen is now in operation at Kansas City, Mo. The Linde Air Products Co. now has 26 distributing stations throughout the country where a supply of oxygen is kept on hand in preparation for immediate shipment.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The Medina Foundry Co., Medina, O., has increased its capital from $75,000 to $150,000.

The Moline Foundry Co., Moline, Ill., has increased its capital stock from $15,000 to $17,000.

Operations have been commenced in the plant of the Line City Foundry Co., South Beloit, Wis.

J. C. Pennington, Windsor, Ont., is preparing plans for the Dominion Stove Co.'s factory to be erected at Kingsville, Ont.

The Ideal Mfg. & Supply Co., Oskaloosa, Ia., has purchased and will operate the old Harrington foundry.

The Jos. F. Rothe Foundry Co., Green Bay, Wis., has been incorporated with $50,000 capital by Jos. F. Rothe, C. Rothe, L. D. Jaseph.

The Dennison Foundry & Engineering Co., Dennison, O., has been incorporated with $50,000 capital by Thomas Wright, E. Vanostram and Maurice Moody.

The Merrill Iron Co., Merrill, Wis., is rushing the reconstruction of its foundry and machine shop, which was badly damaged by fire early in May.

The foundry of the Norwalk Machine & Foundry Co., Norwalk, O., was burned a few weeks ago, the loss being $5,000. Andrew Hamilton, the proprietor, announces that he will rebuild at once.

The Union Manufacturing Co., Boyertown, Pa., is contemplating installing a cupola, molding machines and sand blast apparatus in its foundry.

The Delaware Foundry & Machine Co., Delaware, O., has been incorporated with a capital of $25,000 by Robert Greer, C. C. Stedman, H. M. Bing, F. W. Bauereis and R. E. Hill.

The Peninsular Stove Co., Detroit, has purchased a tract of one and a half acres, on which are several buildings, adjoining its present plant. Some improvements will be made later.

The Chicago Electric Foundry Co., with a capital of $5,000 has been incorporated in Chicago, by Howard S. Bishop, William A. Hartfield and Spencer L. Adams, 69 West Washington street.

A material warehouse 25 x 100 feet and a second story addition to the pattern storage building are being erected at the plant of the Beaver Dam Malleable Iron Co., Beaver Dam, Wis.

Articles of incorporation have been filed in behalf of the Bay Iron Works, Bayfield, Wis. The capital stock is $15,000 and H. C. Weaver, T. A. Bruett and F. S. Blackmarr appear as incorporators.

The Mainland Iron Works, North Vancouver, B. C., according to statements made by R. Fowler, the president, is considering the purchase of a large section of water frontage east of Moodyville, where it will move and enlarge its foundry.

The Reading Casting Co., Reading, Pa., has taken over the business of the Gray Iron Foundry Co., and is making hardware castings. Sand blast equipment and machinery for hot galvanizing and nickel plating has been installed.

The Erie Foundry Co., Rochester, N. Y., has purchased the old foundry plant of the American Laundry Machine Co. on Dewey avenue, and is refitting it to be used as a jobbing foundry to make high grade machinery castings. An addition will be erected 30 x 145 feet for additional molding space, and a cleaning shop, 40 x 100 feet, will also be erected. One 72-inch cupola and other new machinery are being installed, so that the capacity of the present plant will be doubled.

The New Rochelle Foundry Corporation, New Rochelle, N. Y., has been incorporated with a capital stock of $15,000 by F. E. Holler, 122 Fifth avenue, New Rochelle, and others, to do a general jobbing business. It will build a foundry, 65 x 80 feet.

The Lakeside Foundry Co., Detroit, has been organized to conduct a foundry business by William Blanck, A. Russell Keys and Edward Stephens. It is capitalized at $40,000 and has acquired a unit of the former plant of the R. C. H. Corporation.

The Southern Foundry & Machine Co. has been incorporated at Little Rock, Ark., with a capital of $20,000. The incorporators are H. C. Siratt, president, E. A. Backus, E. L. Williams, Chas. C. Bryne, O. Harrison and John C. Fuller.

The Pyle Pattern Works, Muskegon Hts., Ill., recently built an extension to its plant for foundry purposes. The new building includes a molding floor, cleaning room and core room. The molding floor is 50 x 150 feet.

The Pirkl Foundry Corporation, Orchard street, Astoria, New York City, has been incorporated with a capital stock of $25,000 by William Bogen, D. R. Schnepf and others. It has taken over the business and plant of the John Pirkl Iron Works.

The Haish Implement Works, DeKalb, Ill., suffered a loss estimated at $275,000 as the result of a fire which destroyed a large quantity of manufactured stock as well as the equipment in some of the manufacturing departments.

The Scott-Johnston Mfg. Co., Dayton, O., has been organized to do a general manufacturing and foundry supply business. The incorporators are Wesley M. Scott, William Johnston, Charles H. Romer, Cristella A. Johnston and Mary C. Scott.

The Meyrick Pattern Works has been incorporated at Louisville, Ky., to acquire patterns for the manufacture of machinery and agricultural implements. The incorporators include Joseph Meyrick, W. R. Martin and Joseph T. Killmeier Jr.

The Stahler Machine Co., Lewiston, Pa., has been incorporated under the laws of Delaware, to do a general foundry and machine shop business. The capital is $50,000 and the incorporators are M. A. Jones, Reedsville, Pa., F. A. McCabe, G. R. Reynolds and W. R. Holman, Lewiston, Pa.

The Wayne Steel Corporation, Waynesboro, Pa., has been incorporated with a capital stock of $250,000 by H. D. Reynolds and others. It has leased the Greencastle plant of the Emerson-Brantingham Co., which is fully equipped. The new company will manufacture a patented mold.

The New Castle Steel & Iron Co., New Castle, Pa., will increase its capital stock from $350,000 to $500,000. A portion of the new capital will be used for equipping a welding plant. The officers of the company include W. H. Schoen, presdent, H. E. Brainard, secretary and George G. Berger, treasurer.

The Sacramento Foundry & Machine Co., Sacramento, Cal., has been incorporated with $250,000 capital to take over the Sacramento Pump Co. and the Globe Iron Works, North Sacramento, operated by B. F. Taylor, which was forced to close recently. Joseph H. Stephens is president of the new company, J. H. Peterson, vice president, and R. F. Urquahart, secretary-treasurer. The company contemplates enlarging the present plant and installing a steel furnace.

The reorganization of the Pratt & Cady business at Hartford, Conn., has been completed by the formation of a new corporation known as the Pratt & Cady Co., Inc. The officers are Walter B. Lashar, Bridgeport, Conn., president; Bishop White, Bridgeport, Conn., treasurer; W. F. Whitmore, Hartford, Conn., vice president and general manager; E. L. King, Hartford, Conn., secretary. Mr. King was the receiver of the old company. The new organization will continue the manufacture of valves and hydrants.

New Construction

The Arneson Foundry Co., Kenosha, Wis., is building a foundry, 50 x 90 feet.

The Eagle Iron Foundry, Canal street, Salem, Mass., will be rebuilt as soon as possible.

The Springfield Foundry Co., Indian Orchard, Mass., is building a modern concrete addition to its foundry.

The American Car & Foundry Co., 2533 South Wood street, Chicago, is planning a one-story addition to its local plant.

The Birmingham Iron Foundry, Derby, Conn., has placed a contract with the Berlin Construction Co. for a 90 x 100-foot addition to one of its machine shops.

Various contracts have been let for the foundry to be erected by the Fairview Foundry Co., Detroit. This company is controlled by the Chalmers Motor Co.

The addition to the Plymouth Foundry & Machine Co., Plymouth, Wis., is nearly completed and the company already contemplates enlarging the new building.

The Farrel Foundry & Machine Co., Ansonia, Conn., will erect a new brick and steel building as soon as its present building can be torn down.

Harris Bros., Pontiac, Mich., new owners of the plant of the Flanders Mfg. Co., are preparing to rebuild the foundry which is attached to this works. They are represented in Pontiac by D. C. McCord.

The J. C. Miller Block Machine Co., Jackson, Mich., has obtained an option on an adjoining site and is planning to enlarge its capacity and erect a foundry.

A 60 x 80-foot foundry is now under construction for the Cadillac Machine Co., Cadillac, Mich., which will also erect a pattern shop and pattern storage room. The old foundry will be used for structural steel work.

Directors of the Atlas Mfg. Co., Fostoria, O., have decided to purchase land south of the Nickel Plate freight office for the pro-

posed 108 x 140-foot one-story brick factory building.

The Fair Foundry Co., Knoxville, Tenn., which has taken over the Dixie Stove & Mfg. Co., advises that it is making new patterns and constructing an office building and pattern shops. J. E. Fair is president and treasurer of the company.

The Brillion Iron Works, Brillion, Wis., has started work on a steel and concrete office building with 18-inch walls. The building will contain large vaults and a chemical laboratory. The present offices will be devoted to general shop purposes.

The plant of the Buckeye Engine & Foundry Co., which is being erected at Calgary, Alta., will include a foundry, 50 x 70 feet; cleaning room, 50 x 50 feet; blacksmith shop, 50 x 50 feet; pattern shop, 32 x 64 feet, and an office 24 x 32 feet. The plant will be ready for operation about Nov. 1.

Among the Brass Founders

The American Brass Co., Torrington, Conn., has started work on its new foundry.

Sweder's Brass Foundry, Hampton street, South Marquette, Mich., recently suffered a loss by fire of about $1,000.

The Buffalo Brass Foundry Co. has been incorporated in Buffalo, N. Y., with a capital of $5,000.

The Eagle Mfg. Co., Cincinnati, has increased its capital stock from $50,000 to $100,000, and will build an addition to its brass foundry.

G. C. Hester, W. R. Tribbey and R. Ladensolm, of Chicago, have incorporated the Brass & Copper Products Co., with a capital of $25,000.

The machine and pattern shops of the Ocala Iron Works, Ocala, Fla., manufacturers of gray iron, brass and bronze castings, which recently were damaged by fire, will be rebuilt.

The Ulrich Planing Mill Co., Independence, Kan., will start work at some time in the near future on a brass foundry, to be erected in connection with its present plant on Sycamore street.

The W. O. Hickok Mfg. Co., Harrisburg, Pa., manufacturer of bookbinding and paper ruling machinery, will erect a new factory building within the next year. The company will purchase brass and iron foundry equipment, as well as additional wood-working machines and machine tools.

The Michigan Brass & Foundry Co., capitalized at $30,000 to manufacture brass specialties, valves and gas cocks, is planning to locate at Battle Creek, Mich. Frank K. Berry, who is heavily interested in the company, says that the business for the present will be but the company hopes to erect its own factory within a year.

NEW TRADE PUBLICATIONS

ENGINE-DRIVEN COMPRESSORS.—A 16-page bulletin issued by the Chicago Pneumatic Tool Co., Chicago, is devoted to its line of gasoline and fuel-oil engine-driven compressors adapted for a wide range of industrial uses.

SMALL MOTORS.—A recent bulletin issued by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is devoted to the extensive line of small electric motors built by this company. The service of these motors is exceedingly varied and numerous applications are illustrated.

PNEUMATIC TOOLS.—The Ingersoll-Rand Co., 11 Broadway, New York City, recently has issued several bulletins which illustrate and describe riveting hammers, coal, cutters, etc. One 20-page bulletin is devoted to the Ingersoll-Rogler type of air compressor, which is illustrated and described in detail. This compressor is built in four standard strokes, namely, 6, 8, 10 and 12 inches. The distinguishing feature of this compressor is the use of the Ingersoll-Rogler type of air valve.

IRON CEMENT.—Instruction book No. 7, containing 64 pages, has been issued by the Smooth-On Mfg. Co., New Jersey, N. J., which outlines in detail the application of iron cement for stopping leaks in concrete, brick or stone work, for water proofing, dust-proofing, oil-proofing, etc. This iron cement also can be used for stopping leaks of steam, water, fire or oil in iron or steel. Instruction book No. 15, issued by this company, gives full details regarding the application of this material for this work.

CRANES.—An exceedingly comprehensive and well illustrated catalog devoted to its extensive line of cranes has been issued by the Whiting Foundry Equipment Co., Harvey, Ill. This catalog, No. 110, supersedes catalog No. 82. The views of actual installations included represent the wide field of service of the varied line of cranes built by this company. The electric traveling cranes are built in various types, including the three motor with one main hoist, four motor with main and auxiliary hoists, double trolley with duplicate two-motor trolleys, double trolley with main and auxiliary trolleys and double trolley with two main trolleys, one having an auxiliary hoist.

BLOWER EQUIPMENT FOR THE FOUNDRY.—In an exceedingly handsome and well-illustrated 24-page booklet issued by the American Blower Co., Detroit, the blower equipment for a modern foundry is discussed in detail. Considerable space is devoted to the consideration of the heating and ventilating of the modern casting shop and the blast supply to the cupola also is given considerable attention. Blower equipment for foundry exhaust systems is referred to briefly, as well as ventilating apparatus and mechanical draft apparatus for steam boilers.

FOUNDRY SUPPLIES AND EQUIPMENT.—A pocket-size catalog, containing 324 pages, devoted to foundry supplies and equipment, has been issued by the S. Obermayer Co., Chicago. This catalog should prove of value to foundrymen generally, as it is of convenient size to permit of its being carried in the pocket. Practically every conceivable article used in foundry operations is shown and described and a considerable section of this book is devoted to foundry equipment.

RIVETING HAMMERS.—Two bulletins recently ssued by the Ingersoll-Rand Co., 11 Broadway, New York City, are devoted to riveting hammers and rivet set retainers for hammers. All of the riveting hammers can be furnished with a rivet set retainer, which is simple in design and meets the requirements of the safety laws being drafted by the various states. The bulletins are illustrated to show the application of the tools and contain sectional views illustrating details of construction.

BRUSHES.—In a bulletin recently issued by the Munning-Loeb Co., Matawan, N. J., its extensive line of plating and industrial brushes is illustrated and described. The pamphlet contains details of brush manufacture from the making of the block, selection and origin of stock to the finished product. Operating characteristics of the various brush materials and their adaptability to certain classes of work are discussed briefly. The pamphlet will be found a handy guide to the buyer in selecting the best and proper brush for use.

AIR COMPRESSORS.—A 16-page bulletin issued by the Chicago Pneumatic Tool Co., Chicago, is devoted to its line of steam and power-driven enclosed air compressors. Various types are illustrated and described and numerous applications are shown.

THE DETROIT TESTING LABORATORY.—A handsomely illustrated booklet has been issued by the Detroit Testing Laboratory, Detroit, which contains numerous views of the equipment and facilities of this laboratory for making both chemical and physical tests. The directors of this laboratory include W. P. Putnam, J. D. Stoddard, F. W. Robinson and Harry S. Reed. In addition, there are 12 other members of the laboratory staff, which indicate that the organization is unusually well-equipped for commercial work.

FLEXIBLE SHAFT.—In a 96-page catalog the various applications of flexible shaft manufactured by the Stow Mfg. Co., Binghamton, N. Y., are illustrated and described in detail. The wide application of this method of transmitting power permits of its use for operating portable drills of various types, for operating grinders, scratch brushes, etc. in foundries and for buffing, etc. in plating plants. The bipolar multi-speed motor built by this company is also shown, together with its application for stationary grinders, in combination with flexible shaft, etc. In addition, this company builds electric bench grinders, hand and portable drills, internal grinders, etc.

EYE PROTECTORS.—An exceedingly interesting booklet entitled "The Prevention of Eye Accidents" has been issued by the Julius King Optical Co., New York City. Goggles to be worn by foundry operatives are illustrated and numerous letters are included testifying to the value of goggles in protecting the eyes in foundry operations. The eye protectors manufactured by this company afford complete protection for the eyes, yet provide a wide, unobstructed field of vision. An exceedingly interesting chart is published which shows the anatomical distribution of accidents for the year 1913, in the plant of the Pullman Co., Pullman, Ill. Eye accidents lead with a total of 35 per cent, which proves the necessity of eye protection in various shop operations.

WINCHES AND WINDING DRUMS.—A 16-page bulletin issued by the Sprague Electric Works of the General Electric Co., New York City, is devoted to electric winches and winding drums. These machines are designed for all kinds of hauling, usually in a horizontal direction and at comparatively slow speed. One of the most frequent uses is for pulling cars and the self-contained, weather-proof which solves the problem of moving cars on sidings because it may be located at a convenient point and either by direct pull, or with the aid of a snatch-block, it can move the cars when and where desired. This machine also has been used for pulling heavy trucks into and out of shops, for drawing heavy articles on and off drays and for dragging heavy material along the ground in ship yards, stone quarries, etc. The bulletin is well-illustrated and shows various applications of the winch.